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Cover

Nuytsia floribunda (Labill.) R. Br. ex Fenzl (Loranthaceae) – the Western Australian Christmas Tree is one of the few arborescent mistletoes in the world. This endemic tree is a semi-parasite common in sandy soil from the Murchison River to Israelite Bay. The journal is named after the plant, which in turn commemorates Pieter Nuijts, an ambassador of the Dutch East India Company, who in 1627 accompanied the 'Gulde Zeepard' on one of the first explorations along the south coast of Australia.

Photograph: A.S. George

Nuytsia

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DEDICATED TO JENNY CHAPPILL

Western Australian Herbarium
Department of Environment and Conservation
Western Australia

NUYTSIA

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DEDICATION
Dr Jennifer Anne (Jenny) Chappill
1959–2006



We dedicate this issue of *NUYTSIA* to the memory of our friend and colleague, Jennifer Anne Chappill. Jenny made significant contributions to both our knowledge of the Western Australian flora and to the local systematics community, and it is fitting that she be honoured in this way.

Jenny began her career at the University of Melbourne, initially studying Zoology before moving across to plant systematics via a study of one section of *Eucalyptus*, under the supervision of Dr (now Professor) Pauline Ladiges. She then completed a prestigious postdoctoral fellowship at Harvard University, before taking up a lectureship in the Botany Department at the University of Western Australia. Here she remained until her death in August 2006.

Jenny brought with her a passion for systematics matched by an intellectual rigour and fearlessness that saw her take on some difficult tasks with alacrity. Her papers testify to her strongly held belief that systematics should be a truly scientific endeavour (eg. Humphries and Chappill 1988), complete with explicit and testable hypotheses (Chappill 1995) and serious consideration of the theoretical and philosophical basis of the discipline (Humphries and Chappill 1988, Chappill 1989).

In her study of legume phylogeny, Jenny committed herself to a major undertaking well suited to her innate persistence and tenacity. In both her own work on *Jacksonia* and other legumes, and in collaboration with her students on such varied groups as Malvaceae, Stylidiaceae, Proteaceae, Ericaceae and bryophytes, Jenny made important and timely contributions to our knowledge of the local and wider Australian flora.

Her role as teacher was one that Jenny took seriously. As a new academic, she had a clear vision of how she wanted to develop the teaching of systematics at both undergraduate and postgraduate level, and she worked tirelessly to bring this to fruition. She resolutely maintained the position that plant systematics – as opposed to study of theory-free plant diversity and identification – retains a central place in the education of modern botanists and conservation biologists. Jenny was also unwavering in her view of morphology as a prime source of phylogenetic data, and ensured her students were highly skilled in the delimitation and analysis of morphological characters.

Jenny supervised most of our recent Western Australian graduates with higher degrees in plant systematics. As a result of her commitment to excellence, our community contains a group of highly trained systematists who are strongly grounded in systematic theory and taxonomic practice, and with significant skills in morphology and anatomy at a time when these skills are becoming scarce.

This may well prove to be her most significant long-term contribution to systematics, and it is my belief that the retention of her highly trained graduates in WA, as practising systematists, will be the most significant memorial we can offer to Jenny and her work.

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***Coprinopsis stangliana* – a recently introduced fungus expanding in urban bushlands of the Perth region of Western Australia**

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Abstract

Bougher, N.L. *Coprinopsis stangliana* – a recently introduced fungus expanding in urban bushlands of the Perth region of Western Australia. *Nuytsia* 16(1): 3–10 (2006). Successively for the past ten years a distinctive, large fungus superficially resembling the northern hemisphere Magpie Fungus *Coprinopsis picacea* syn. *Coprinus picaceus* has been observed for the first time in Western Australia (WA). The fungus is a member of the section *Coprinus* subsection *Alachuani*. Based on morphological and habitat attributes, the WA fungus is considered in this paper to be affiliated with *Coprinopsis stangliana* syn. *Coprinus stanglianus*. *C. stangliana* is known from calcareous soil, limestone, and chalk in Europe and Turkey, but has not been confirmed in Australia. In WA, *C. stangliana* generally has larger fruit bodies than reported for this species elsewhere. The fungus produces abundant fruit bodies in highly disturbed patches within numerous urban bushlands of the Perth region. The apparent recent establishment of such a conspicuous fungus, and observations of its fruiting patterns over successive years suggest that it is rapidly spreading following a relatively recent introduction into the Perth region.

Introduction

The genus *Coprinus* Pers. consists of dark-spored fungi generally referred to as ink caps, as many of the species autodeliquesce (self-digest) into a black liquid as they mature. Over 745 names have been applied to *Coprinus* (Index Fungorum 2006), representing at least 350 species (Kirk *et al.*, 2001). Over 50 of the species have been recorded in Australia (May *et al.* 2005), and 15 in Western Australia (WA) (Hilton 1982, 1988). Recent phylogenetic analyses of molecular sequences have indicated that *Coprinus* is not monophyletic (Redhead *et al.* 2001). The type species of *Coprinus* – *C. comatus* and a few related species remain as *Coprinus* aligned with the Agaricaceae. The vast majority of other species formerly considered *Coprinus* have been allocated by Redhead *et al.* (2001) to genera aligned with the Psathyrellaceae – *Coprinopsis* P. Karst., *Parasola* Redhead, Vilgalys & Hopple, and *Coprinellus* P. Karst. These genera are not accepted universally (e.g. Kirk *et al.* 2001; May *et al.* 2005). The present author accepts the genera after taking into account congruence of some long-recognized morphological attributes with the molecular phylogeny (as discussed by Redhead *et al.* 2001).

During the past 10 years the author and colleagues have observed a large, distinctive species of *Coprinopsis* in highly disturbed patches within numerous urban bushlands in the Perth region over successive years. The fungus has not been seen in WA before this time (K. Griffiths, R.N. Hilton, E. McCrum pers. comm.). This paper examines the identity of this fungus. The fungus has the stature

of the northern hemisphere Magpie Fungus – *Coprinopsis picacea* (Bull.: Fr.) Redhead, Vilgalys & Moncalvo [*Coprinus picaceus* (Bull.: Fr.) Gray], but is considered in this paper to be more closely affiliated with *Coprinopsis stangliana* (Enderle, Bender & Gröger) Redhead, Vilgalys & Moncalvo [*Coprinus stanglianus* Enderle, Bender & Gröger].

Coprinopsis picacea is aptly named the Magpie Fungus because of its dark cap neatly adorned with thick white patches of veil. It occurs widely throughout temperate regions of the world, particularly on calcareous soils. It is not an abundant fungus in the northern hemisphere - variously considered as “found only occasionally” (Dickinson and Lucas 1979), “rare” (Breitenbach and Kränzlin 1995), “widespread but local” (Orton and Watling (1979), or “found it only once, but not uncommon in southern California” (Arora 1986). Records of the Magpie Fungus in Australia are scant. May *et al.*, (2005) list the only records as Hennings (1898) and Dickinson & Lucas (1979). Both are not likely to be first-hand reports. The reports may stem from *Coprinus picaceus* sensu Cooke (Cooke 1892) which is a misidentification of *Coprinus gigasporus* Massee from Brisbane, Queensland (Massee 1896; May *et al.* 2004). *C. gigasporus* has very large spores: 28–30 × 14–16 µm (Massee 1896). McAlpine (1895) also listed *C. picaceus* sensu Cooke in his Systematic Arrangement of Australian Fungi.

Coprinopsis stangliana is generally considered to be a smaller fungus than *C. picacea*. In the Netherlands *C. stangliana* is known as “kleine spechtinktzwam” while *C. picacea* is known as “spechtinktzwam”. *Coprinopsis stangliana* is also distinguished from *C. picacea* by having spores under 10 µm wide. *C. stangliana* is reported to be a rare but widespread species in Europe found on calcareous soil or chalky loam (Bender & Enderle 1988, Uljé and Noordeloos 1997). *C. stangliana* was recognized and published for the first time in Britain only recently by Henrici and Laessle (1993) who found it in troops in a calcareous grassland. It is also known in Mediterranean Turkey (Kaya 2001). *C. stangliana* has not been reported in Australia.

Methods

Fresh fruit bodies collected from the field were described, and then air-dried for later examination. Hand sections for microscopic observations were mounted in 3% KOH and in 1% Congo Red. Microscopic characters were drawn with a Nikon drawing tube system. Spore measurements include the hilar appendix.

Taxonomic description

Coprinopsis stangliana (Enderle, Bender & Gröger) Redhead, Vilgalys & Moncalvo, *Taxon* 50: 231 (2001). *Type*: near Bissengen, Baden-Württemberg, Germany, 29 May 1986, M. Enderle & G.J. Krieglsteiner s.n. (holo: M). *Basionym*: *Coprinus stanglianus* Enderle, Bender & Gröger, in Bender & Enderle, *Zeitschrift für Mykologie* 54: 57–64 (1988).

Pileus 45–60 mm tall × 45–50 mm wide when unexpanded, conical in button stage, elevating upon rapidly elongating stipe before expanding to conico-campanulate up to 100–125 mm diam. Finally deliquescent with highly reduced, dissected and distorted portions of pileus weeping and dripping from the apex of the white stipe which remains upstanding at this stage. Margin thin, becoming ragged and deeply split with age. Button entirely white to cream with pale brown tinges (see data about the veil,

below). Surface of unexpanded pileus on elongated stipe grey except yellow-brown at apex, darkening from margin inwards, finally dark grey to black when old. Surface dry and felty at first (button) becoming moist-greasy, finally wet and dripping, finely radially grooved from margin to centre. Context white. *Veil* felty, contiguous, entirely enveloping unexpanded fruit bodies at first then soon breaking up into two forms as the pileus expands: (a) Thick, plaque-like, densely matted, white to cream blocks up to 5 mm wide. Some plaques especially near the pileus centre with pale brown tinges due to a thin membranous surface layer; (b) Underneath and in between the plaques the veil is appressed, loosely matted, fibrillose, white, much thinner in profile than the plaques, and not as densely matted as the plaques in surface view. *Lamella* to 10 mm broad, free, becoming distant from stipe, crowded, pale cream at first, soon becoming bluish-grey then black and moist, finally deliquescent. Edges whitish-grey, glistening under lens. *Stipe* 100–200 mm in length, 10–20 mm broad, cylindrical to slightly narrowing towards apex, with swollen to angular base up to 30 mm broad, without volva, hollow, white except for spore-stained zones and brown colouration at extreme base due to scant velar remains, dry, finely felty (not conspicuous after handling). Fragile, easily broken if bent, and easily separated from pileus. Context white. *Basal mycelium* dull white, thin and/or thick rhizomorphs (up to 1.5 mm broad) loosely binding a clod of rich, organic, decomposed litter and woody material. *Macrochemical test* 15% KOH no reaction on pileus or stipe surface and context. *Odour* not distinctive. *Taste* mild. *Spore print* black. *Basidiospores* $10.5\text{--}14\text{ (}14.5\text{)} \times (7.7)\text{--}10\text{ (}10.5\text{)}\text{ }\mu\text{m}$ ($n=180$), side view mean $12.1 \times 8.4\text{ }\mu\text{m}$, mean L/B ratio 1.45 ($n=90$), face view mean $12.1 \times 8.9\text{ }\mu\text{m}$ ($n=90$), mean L/B ratio 1.34. Greyish-brown when immature becoming dark brown then black when mature in 3% KOH or water. Ellipsoid or broadly ovoid, slightly amygdaliform in side view, smooth, thin-walled. Germ pore central, barely truncate to broadly truncate (strongly evident in some immature spores). *Basidia* $25\text{--}36 \times 10\text{--}12\text{ }\mu\text{m}$, clavate to cylindric, pedicellate with cylindric neck $3\text{--}4\text{ }\mu\text{m}$ broad, sterigmata up to $5\text{ }\mu\text{m}$ in length, 4-spored, collapsing, clamped at base. Spaced apart by swollen, vesiculose, thin-walled pavement cells up to $20\text{ }\mu\text{m}$ broad. *Lamellae trama* parallel, smooth-walled, hyphae $1.5\text{--}3\text{ }\mu\text{m}$ broad. *Subhymenium* hyphae similar to trama. *Pleurocystidia* $90\text{--}120\text{ (}175\text{)} \times 25\text{--}50\text{ }\mu\text{m}$, utriform, broadly lageniform, ventricose, largest cystidia often cylindrical with obtuse apex, all abruptly tapering near base to narrow septum, hyaline, smooth-walled, scattered singly, collapsing, clamped at base. *Cheilocystidia* $50\text{--}120\text{ (}175\text{)} \times 22\text{--}45\text{ }\mu\text{m}$, clavate with narrow neck $6\text{--}10\text{ }\mu\text{m}$ broad, broadly lageniform, hyaline, smooth-walled, sometimes with mucilaginous material adhering near apex, hyaline, crowded in young hymenium, collapsing, clamped at base. *Pileipellis* tightly-packed, parallel hyaline hyphae $2\text{--}9\text{ }\mu\text{m}$ broad, septa constricted, with clamp connections. *Pileus trama* similar hyphae merging with the pileipellis, inflated up to $30\text{ }\mu\text{m}$ broad. Scattered oily or glassy, sinuous hyphae up to $6\text{ }\mu\text{m}$ broad present. *Veil elements* interwoven, thin-walled hyphae $4\text{--}15\text{ (}20\text{)}\text{ }\mu\text{m}$ broad. Mostly smooth-walled but some with minute encrustations. Some hyphae rarely branched, other types highly branched or with some short diverticulate projections or branches. *Clamp connections* present on most septa. (Figures 1, 2)

Specimens examined. Kings Park, Perth, in sand among weeds next to sand track north off Lovekin Drive near DNA tower broadwalk under *Allocasuarina fraseriana*, 2 June 1997, N. Bougher & M. Bougher s.n. (PERTH 07240562, formerly CSIRO E5834); Kings Park, Perth, in litter next to track under tuart (*Eucalyptus gomphocephala*), 13 June 1999, N. Bougher & M. Bougher s.n. (PERTH 07240570, formerly CSIRO E6058); Bold Park, Perth, $31^{\circ} 56' 34.5''\text{ S } 116^{\circ} 46' 48.1''\text{ E}$, among weeds in tuart (*Eucalyptus gomphocephala*) open woodland south of Reabold Hill (near peg 3586), 4 July 1999, N. Bougher & R. Wills s.n. (PERTH 07240694, formerly CSIRO E6190); Yanchep National Park, Perth, $31^{\circ} 33' 10.3''\text{ S } 115^{\circ} 41' 01.7''\text{ E}$, in organic humus at side of track among weeds in tuart (*Eucalyptus gomphocephala*) open woodland, limestone outcrops in vicinity, 15 June 2004, N. Bougher & R. Hart s.n. (PERTH 07240589, formerly CSIRO E8013); Star Swamp, Perth, $31^{\circ} 50' 59''\text{ S } 115^{\circ} 45' 29''\text{ E}$, amid weeds near side of track in *Eucalyptus marginata* and *C. calophylla* woodland, 19 May 2005, N. Bougher s.n. (PERTH 07240708, formerly CSIRO E8174); Mindarie Bushland, Long Beach Promenade, Mindarie, Perth, amid weeds near side of limestone track in *Eucalyptus gomphocephala* open woodland, 19 June 2005, N. Bougher &

J. Weaver s.n. (PERTH 07240716, formerly CSIRO E8219); Rockingham Lakes Regional Park, Lake Cooloongup, South Cooloongup, Perth, 32° 17' 44.2" S 115° 46' 36.5" E, in litter under *Eucalyptus gomphocephala*, 21 June 2005, *N. Bougher & P. Davison s.n.* (PERTH 07240597, formerly CSIRO E8225); Warwick Open Space (near corner Warwick Rd and Lloyd Drive), Warwick, Perth, in mulch in the Warwick Leisure Centre carpark, near a patch of remnant *Corymbia calophylla* woodland, 26 June 2005, *K. Clarke & M. Brundrett s.n.* (PERTH 07240724, formerly CSIRO E8239).

Distribution and Habitat. *Coprinopsis stangliana* has been confirmed only from the Perth region in Western Australia, but it or similar fungi may occur in other parts of Australia, e.g. a smaller-spored fungus labeled *Coprinus 'albosquamosus'* from South Australia (P. Catcheside, pers. comm.), and a fungus recently photographed as "*Coprinus picaceus* group" in East Gippsland, Victoria by K. Thiele. In WA this fungus produces conspicuous fruit bodies emerging well above the soil or litter, singly or in troops often clustered within small, discrete patches. It can be recognized by its large size and tall,



Figure 1. A – *Coprinopsis stangliana* (PERTH 07240589), Yanchep National Park. Note the thick veil enveloping the button stage, and irregular, mainly thin patches of veil on the mature fruit bodies; B – C: *Coprinopsis stangliana* (PERTH 07240694), Bold Regional Park. Note the weedy habitat, fallen leaves of tuart (*Eucalyptus gomphocephala*), and a native fringed lily (*Thysanotus*): B – immature fruit bodies; C – matured fruit bodies from same patch as shown in B; D – *Coprinopsis stangliana* (PERTH 07240597), Warwick Open Space. Note in these specimens the veil persists as thick, well-formed, quite uniform plaque-like patches that extend over much of the pileus.

hollow white stem, white veil patches on the grey, finely-grooved pileus, and the presence of at least some dull white rhizomorphs emerging from the swollen stem base and binding the humus. In dry conditions the veil persists as thick, well-formed, quite uniform plaque-like patches that extend over much of the pileus (Figure 1D). In wetter or moist conditions the plaques may be scarce on mature specimens (Figures 1A, B). Only zones of thin, appressed veil may then persist, especially near the pileus margin. The tall white stipe of older fruit bodies is topped with ragged, black, weeping remains of the pileus (Figure 1C).

C. stangliana produces abundant fruit bodies in many urban bushlands throughout the Perth region, particularly in tuart (*Eucalyptus gomphocephala*) or *Banksia*-dominated woodlands. The fungus has been observed almost exclusively in highly disturbed patches within the bushlands such as heavily weeded areas, aside of tracks in organic humus among weeds, or on recently piled earth. Up to 20 or more fruit bodies often cluster around the immediate vicinity of these sites but rarely beyond. This fungus often produces successive crops of fruit bodies over a sustained period during the main local fungal fruiting season (May – August).

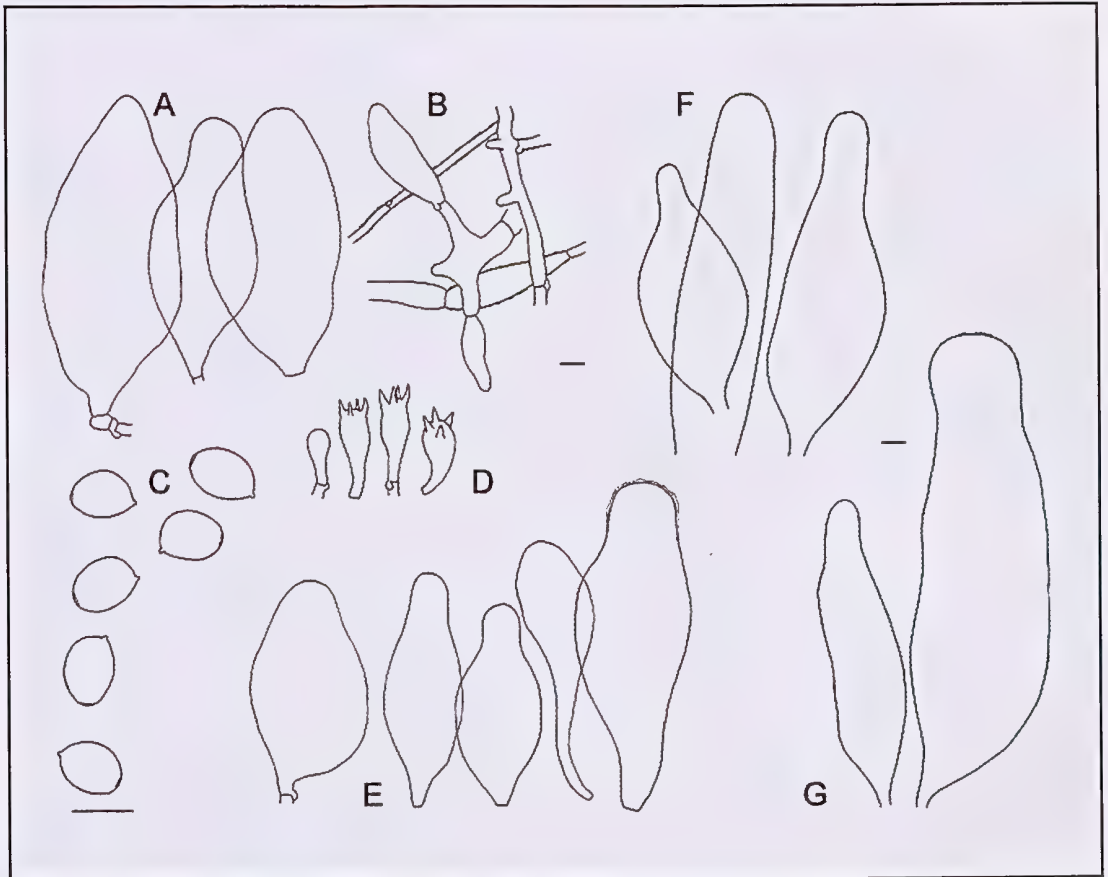


Figure 2. A–G: micromorphology of *Coprinopsis stangliana* (A–E all from PERTH 07240694): A – pleurocystidia; B – veil elements from the pileus of a mature fruit body; C – spores; D – basidia; E – cheilocystidia; F – pleurocystidia (PERTH 07240570); G – pleurocystidia (PERTH 07240589). Scale bars = 10 μ m (longer bar for spores only).

Affinities. The hyphal pileipellis structure of this fungus aligns it with the genus *Coprinopsis* as defined by Redhead *et al.* (2001). Currently 12 species of *Coprinus* sensu lato reported in Australia are assignable to *Coprinopsis* (May *et al.* 2005). Of these species, the WA fungus described in this paper is closest to *C. picacea* but differs from that species in several significant attributes:

- (a) All examined collections of the WA fungus have spores entirely or predominantly 10 µm or less broad. The possession of spores greater than 10 µm broad is the major character which distinguishes *C. picacea* from almost all other *Coprinus* species of section *Coprinus* subsection *Alachuani* (fungi with loosely attached veil composed of branched, diverticulate hyphae, Uljé and Noordeloos 1997).
- (b) The veil of WA *Coprinopsis* does not form a neat pattern of uniform-sized and concentrically arranged thick scales characteristic of *C. picacea* (as usually illustrated as typical e.g. Dickinson and Lucas 1979; Breitenbach and Kränzlin 1995).
- (c) The surface of the unexpanded cap of WA specimens is not as dark grey to black as is illustrated as typical of *C. picacea*.
- (d) *C. picacea* reportedly has a “strong” odour (Orton and Watling 1979), described as “gas-like or like creosote” (Breitenbach and Kränzlin 1995), or “like that of mothballs, a hot grass pile, or burnt hair or rank” (Arora 1986). The WA fungus does not have a distinctive odour.
- (e) Cystidia of the WA fungus (see Figure 2) are similar in size to those of *C. picacea* but are more predominantly lageniform and many have a prominent apical extension. The cystidia of *C. picacea* are variously described and illustrated as clavate-ventricose, utriform, ellipsoid, conical, cylindric, cylindric-vesiculose or fusiform (e.g. Orton and Watling 1979, Uljé and Noordeloos 1997, Breitenbach and Kränzlin 1995). Lageniform cystidia are not mentioned or illustrated for *C. picacea*, except by Orton and Watling (1979) for cheilocystidia which they describe as “cylindric or vesiculose to narrowly lageniform, 60–80 × 20–30 µm”.

Two other macroscopically similar species of the section *Coprinus* subsection *Alachuani*, but with spores less than 10 µm broad, are *C. kimurae* (Hongo & Aoki) Redhead, Vilgalys & Moncalvo and *C. stangliana*. *C. kimurae* occurs on material such as straw, rotting coconut matting, cotton textiles, and differs from the WA specimens by having subglobose spores. *C. stangliana* has similar macroscopic and microscopic morphology to the WA fungus. For example, cystidia with an apical extension such as are abundant in the WA fungus match those illustrated by Bender & Enderle 1988, and Uljé and Noordeloos 1997 for *C. stangliana*. Ecological preference for basic soils may also point to a similarity between the WA fungus and *C. stangliana*. Like *C. picacea*, *C. stangliana* also occurs predominantly on calcareous soil, limestone and chalk (Uljé and Noordeloos 1997). The WA fungus appears to be particularly abundant in tuart (*Eucalyptus gomphocephala*) communities. Tuart is endemic to the Swan Coastal Plain and predominantly occurs on aeolian sands derived from underlying limestone (Keighery *et al.* 2002). *C. stangliana* recently has been reported in a Mediterranean climatic region (in Turkey, Kaya 2001). It may be expected to occur in other Mediterranean regions of the world, such as south-western Australia.

Several attributes differentiate the WA fungus from the current concept of *C. stangliana*. Members of *Coprinopsis* subsection *Alachuani* such as *C. picacea* and *C. stangliana* exhibit a capacity for high variability in size. The WA fungus also varies in size but its pileus (45–60 × 45–50 mm) is larger than the size range variously reported for *C. stangliana*, e.g. 15–40 × 10–25 mm (Uljé and Noordeloos 1997), up to 33 (45) × 30 (40) mm (Bender & Enderle 1988), 20–40 × 45 mm (Henrici and Laessøe 1993). Also the stipe of this fungus (100–200 × 10–20 mm) is larger than reported for *C. stangliana*, e.g. stipe up to 70 (120) mm long × 6 mm wide (Bender & Enderle 1988), up to 120 mm tall (Uljé and Noordeloos 1997), 40–120 × 10 mm (Henrici and Laessøe 1993). The spores of the WA *Coprinopsis*, 10.5–14 (14.5) × (7.7) 8–

10(10.5) μm , overlap with, but extend beyond, the upper size ranges reported previously for *C. stangliana*. The spores of *C. stangliana* have been reported to be (8.6)9.5–11.3 (12.5) \times (6)6.5–7.5 (8.5) μm (Bender & Enderle 1988), 8.6–12.6 \times 6.1–8.9 μm (Uljé and Noordeloos 1997), 10–12.5 \times 6.5–8.5 μm (Henrici and Laessøe 1993). Clarification of the relationships between the WA fungus, herein assigned as a robust form of *C. stangliana*, and other members of the section *Coprinus* subsection *Alachuani* will be undertaken in a molecular phylogenetic study.

Recent introduction

It is surprising that this conspicuous fungus affiliated with *C. stangliana* previously has not been reported in Western Australia, or indeed Australia. Henrici and Laessøe (1993) expressed similar surprise upon the recent discovery for the first time of *C. stangliana* in Britain. Recent discovery in WA of *C. stangliana* would be less surprising if this fungus was either inconspicuous, or rare. However, it is distinctive, large, and occurs in troops observed in many bushlands of the Perth region over the past 10 years. This includes in well-studied bushlands such as Kings Park where intensive botanical and student mycological excursions have been undertaken annually since the early twentieth century. It is unlikely, though not impossible that this fungus simply had been overlooked in the bushlands (and elsewhere) before 10 years ago.

Aside from the absence of sightings until recently, several observations suggest that *C. stangliana* is rapidly spreading following a relatively recent introduction into the Perth region. The fungus produces a massive spore load, often heavily self-printing on the stem and blackening the surrounding litter, in restricted discrete highly disturbed patches within bushlands. Abundant insects observed in association with deliquescing fruit bodies may aid spore dispersal. In at least some cases observed over many successive years, the fruit bodies of this fungus have spread rapidly outwards from initially small foci. This is the case with an occurrence at Bold Regional Park observed over 6 successive annual fruiting seasons. Initially, during the first year of observation, scattered fruit bodies were confined to a patch of approximately 3 m². The area with fruit bodies expanded outwards by 3–5 metres each subsequent season. Climatic conditions varied and affected fruiting to different extents in different seasons, but during most seasons the fruit bodies occurred near the perimeter as well as scattered throughout the occupied area.

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***Logania wendyae* (Loganiaceae), a new species from south-west Western Australia**

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Abstract

Cranfield, R.J. and Keighery, G.J. *Logania wendyae* (Loganiaceae), a new species from south-west Western Australia. *Nuytsia* 16(1): 11–14 (2006). *Logania wendyae* Cranfield & Keighery, a new species endemic to the Jarrah Forest bioregion of south-western Western Australia is described, illustrated and mapped.

Introduction

The new species described here is known only from three collections made in the Argyle and Dardanup forest blocks around Donnybrook in south-western Western Australia. The original collection of this distinctive new species was made in 1996 during a flora survey of Dardanup Forest Block (Keighery *et al.* 1997).

This taxon was originally considered to represent *Logania serpyllifolia* subsp. *angustifolia* (Benth.) B.J. Conn or one of its variants, however, several characters were recognised as different, such as flower size, hairiness of leaves and apparent habitat differences. On this basis, plants from the Donnybrook area are considered to represent a new taxon of *Logania* sect. *Stomandra* (R. Br.) DC., described here as *L. wendyae*.

Taxonomy

Logania wendyae* Cranfield & Keighery, *sp. nov.

Fruticulus erectus ad 5–17 cm altus. Ramuli teretes, plus minusive sulcati, dense tomentosi. Folia subsessilis, lamina linearis–anguste ellipticus, 9–25 mm longus, 2–5 mm latus. Inflorescentia terminales, 1–3 flores, flores perfecti, pedunculus 0.5–1 mm longus. Corolla 9–12 mm longa, tubus 4.5–6 mm longus, lobi obovati, 4.5–6 mm longi. Stamina in sinu inter lobes corollae insertae.

Typus: Dardanup forest block [precise locality withheld], Western Australia, 30 Oct. 1996, *G.J. Keighery* 15011 (*holo*: PERTH 05121906).

Decumbent dwarf *shrub*, 5–17 cm high, up to 30 cm wide with a spreading woody rootstock. *Branches* ridged, moderately to densely hairy, hairs patent to spreading, white, usually 0.2–1 mm long. *Leaves* discolorous, subsessile, moderately to densely hairy; stipules membranous, triangular, 1.5–3 mm long, apex obtuse to acute; lamina lanceolate to narrowly-elliptic, 9–25 mm long, 2–5 mm wide, moderately hairy, indumentum on all surfaces with long erect hairs mainly on the midrib and margins of the abaxial surface; hairs white, patent, 4–6 mm long; lamina base attenuate, narrowed for basal 2–3 mm; margin recurved; apex acute to subacute. *Leaves* subtending the inflorescence usually longer (20–25 mm long vs 9–15 mm) and broader (4–5 mm vs 2–4 mm), exceeding the flowers. *Inflorescence* terminal, triadic or reduced to a single flower, mostly reduced cymose, 1–3 flowered with one flower opening at a time, the remaining two either aborting or opening later; peduncle short, 0.5–1 mm long; flowers bisexual, odour foetid; pedicel 0.5–1 mm long, densely hairy; prophylls linear, 3–4(9) mm long, 0.5–1 mm wide, hairy, apex long-attenuate. *Calyx* black, outer surface moderate-densely hairy, particularly on margins; lobes narrowly linear to narrowly ovate, 7–10 mm long, 0.5–1 mm wide, margin membranous, apex long-attenuate. *Corolla* white, tinged with blue, 9–12 mm long; outer surface glabrous, inner surface densely papillose; tube 4.5–6 mm long; lobes obovate, 6–9.5 mm long, 2–3.5 mm wide, apex rounded to subacute. *Stamens* exserted; filaments inserted in sinus between lobes, 1.5–2 mm long, filiform; anthers 1–2 mm long. *Pistil* 4–6.5 mm long; ovary 1.5–2 mm long, with sparse glandular hairs; style 3–5 mm long; stigma ellipsoid, 2 mm long, 0.5 mm wide. *Capsule* ovoid, 5–6.5 mm long, *c.* 2 mm wide, sparsely hairy. Seed not seen. (Figure 1)

Other specimens examined. WESTERN AUSTRALIA: E. of Capel, 18 Oct. 2000, R.J. Cranfield 15680, (PERTH 07342101); W. of Capel-Donnybrook road, 22 Oct. 1997, R. Davis 4414 (PERTH 04929349).

Distribution and habitat. Known from three collections from two forest blocks around Donnybrook in south-western Western Australia. Occurs in *Eucalyptus marginata*, *Corymbia haematoxylon* – *Allocasuarina fraseriana* forest or low woodland on exposed colluvial brown clay to sandy clay soils associated with laterite gravels. (Figure 2)

Phenology. Flowering in October.

Conservation status. Conservation Codes for Western Australian Flora: Priority One. This species is known only from two areas close to the type locality and appears to be restricted to a few individuals in each population, none of which are located in conservation reserves. Additional surveys are required to determine whether this species occurs in the Whicher Range area south of the currently known populations.

Etymology. Named in honour of the first author's wife Wendy, who has accompanied him often on field work and supported his botanical career.

Notes. The long white hairs of this species are easily observed and mask the leaves, compared to *Logania serpyllifolia* subsp. *angustifolia*, in which the leaves are sparsely hairy (Figure 1). Many of the specimens of *L. serpyllifolia* subspecies *angustifolia* examined have darkened almost to black, a feature common in *Logania*. This darkening has not been observed in samples of *Logania wendyae*.

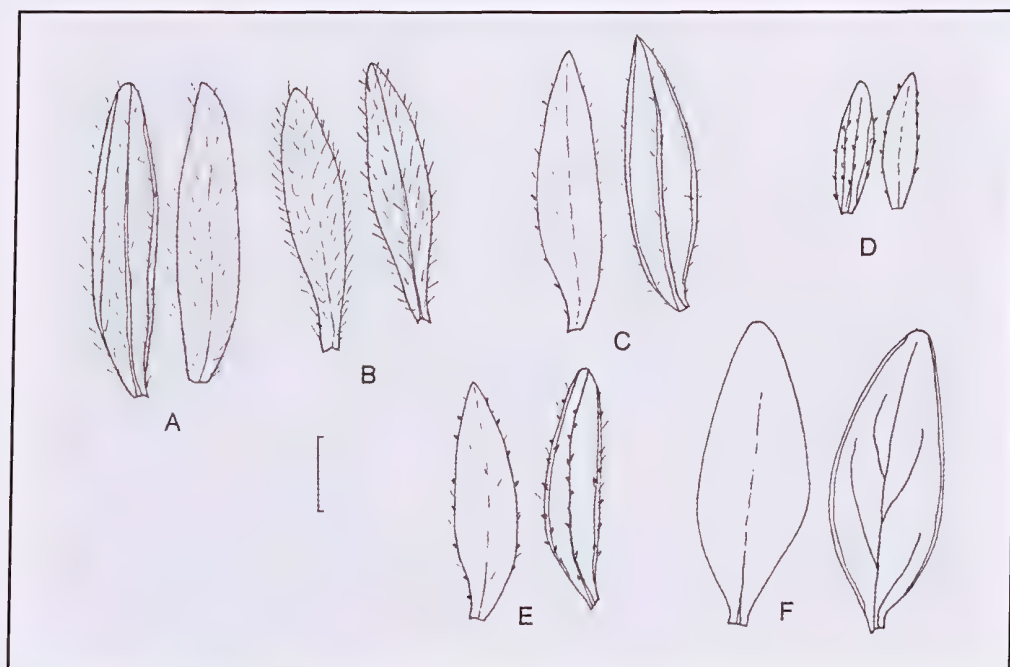


Figure 1. Differences in upper and lower leaf surfaces between *Logania wendyae* and *L. serpyllifolia* subsp. *angustifolia*. A–B *Logania wendyae*, A – R. Davis 4414 (PERTH 04929349), B – G.J. Keighery 150110 (PERTH 05121906). C–F *Logania serpyllifolia* subsp. *angustifolia*, a range of forms, C – B.G. Hammersley 1536 (PERTH 04560779), D – J. Koch s.n. (PERTH 01673548), E – B.J. Conn 3335 (PERTH 03314367), F – R.D. Royce 4654 (PERTH 1670395). Scale bar = 5 mm.

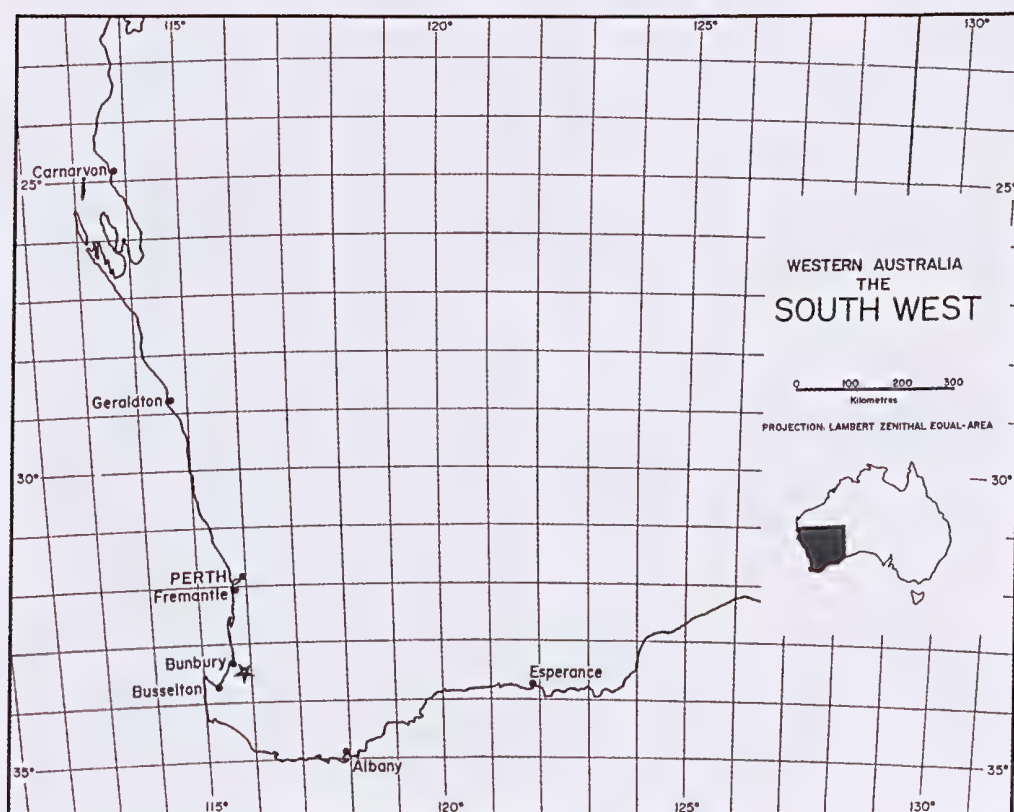


Figure 2. Distribution of *Logania wendyae* (★).

Amendment to the “Flora of Australia” key.

To allow recognition of *L. wendyae*, the key in the “Flora of Australia” (Conn & Brown 1996) should be altered to read:

- 5: Plant low, branching, erect or spreading; corolla 4–13 mm long;
calyx lobes tapering, subulate or long-attenuate
- 7 Inflorescences terminal on short lateral branches, appearing axillary;
calyx glabrous, usually with a few minute papillae on midrib of outer surface27. *L. pusilla*
- 7: Inflorescences distinctly terminal, not on short lateral branches;
outer surface of calyx hairy, particularly medially and marginally
- 7a Corolla 4.5–8.5 mm long, leaves glabrescent 28. *L. serpyllifolia*
- 7a: Corolla 10–12 mm long, leaves with persistent long white hairs 34. *L. wendyae*

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***Boronia barrettiorum* (*Boronia* subseries *Filicifoliae* : Rutaceae),
a new species from the Kimberley Region of north-western Australia**

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Abstract

Duretto, M.F. *Boronia barrettiorum* (*Boronia* subseries *Filicifoliae* : Rutaceae), a new species from the Kimberley Region of north-western Australia. *Nuytsia* 16(1): 15–20 (2006). *Boronia barrettiorum* Duretto *sp. nov.* (*Boronia* subseries *Filicifoliae* : Rutaceae) is described and its relationships discussed. Variation in *B. pauciflora* W.Fitz. is also discussed and a key to the species of *Boronia* found in the Kimberley Region is provided.

Introduction

The Kimberley Region of northern Western Australia is a minor centre of endemism for *Boronia*. Wheeler (1992), in the first regional account of the genus, illustrated and gave accounts for four species (*B. filicifolia* A.Cunn. ex Benth., *B. lanuginosa* Endl., *B. pauciflora* W.Fitz. and *B. sp. A*). Wheeler also discussed a number of taxonomic problems. A phenetic analysis of the *B. lanuginosa* species-complex (Duretto 1997) identified two widespread species, *B. lanuginosa* and *B. wilsonii* (F.Muell. ex Benth.) Duretto (both found in the Kimberley Region and the N.T.), as well as three, additional, narrow endemics for the Kimberley Region (*viz.* *B. jucunda* Duretto [*B. sp. A*], *B. kalumburuensis* Duretto and *B. minutipinna* Duretto). In 1997 a most unusual species was collected from near Kalumburu and described as *B. anomala* Duretto (Duretto 1999). All species of *Boronia* found in the Kimberley Region are placed in *Boronia* section *Valvatae* and, apart from *B. anomala* (which is *incertae sedis* in the section), in *Boronia* subsection *Grandisepalae* series *Lanuginosae* (Duretto 1999). The series contains three subseries, all of which are found in the Kimberley Region: subseries *Lanuginosae* (*B. lanuginosa*, *B. wilsonii*), subseries *Jucundae* (*B. jucunda*, also found in the N.T., with two additional species from the N.T.), and subseries *Filicifoliae* (the remaining four species). *Boronia* subseries *Filicifoliae* was considered to be confined to the Kimberley Region until the collection (in 1999) and formal description (Duretto 2003) of *B. gravicocca* Duretto from the north-west of the Northern Territory. Most species in the Kimberley are narrow endemics on sandstone and known from few collections.

Recent collections from the Prince Regent River area made by Russell and Matt Barrett (Kings Park, Botanic Gardens and Parks Authority, W.A.) have proved to be an undescribed species of *Boronia*. The species is allied to *B. pauciflora* in *Boronia* subseries *Filicifoliae*. The opportunity is taken here to publish a formal description and a detailed account of the species before the forthcoming *Flora of Australia* treatment of the genus.

Taxonomy

Boronia barrettiorum* Duretto, *sp. nov.

A Boronia pauciflora W.Fitz. foliis indumento stellato modice denso differt.

Typus: 15 km N of junction of Youwanjela Creek and Prince Regent River, Kimberley Region, Western Australia, 15°36' S 125°29' E, 28 Jan. 1999, *M.D. Barrett* 600 (*holo*: PERTH 06347851; *iso*: HO).

Erect, open *shrub* to 150 cm high; with a moderately dense stellate indumentum throughout, apart from flowers. *Multiangular stellate hairs* sessile, with up to 20 (occasionally more) rays; rays unicellular, unfused, firm, straight, not appressed, glossy, smooth, to 0.5(–1.5) mm long. *Branches* roughly circular in outline, decurrent leaf bases absent, not obviously glandular, hairs evenly distributed around stem, becoming glabrous with age. *Leaves* 1- or 3-foliate, usually both types present on a given branch though in varying proportions; simple leaves and terminal leaflets longer than lateral leaflets, 10–33 mm long, 4–11.5 mm wide; lateral leaflets 5–19 mm long, 3–7 mm wide; trifoliate leaves sessile, simple leaves petiolate, petioles and petiolules to 3 mm long; lamina of simple leaves and pinnae ovate to lanceolate to elliptic, acute, attenuate, discolorous, paler beneath, not obviously glandular; margins entire, flat; midrib slightly impressed adaxially, raised abaxially. *Inflorescence* 1(–3)-flowered; peduncle absent; bracts minute; anthopodium (pedicel) 5–25 mm long. *Flowers* white, becoming green with fruit. *Sepals* slightly larger to slightly smaller than petals, narrowly ovate-deltate, acute to acuminate, 2.5–3.75 mm long, 1–1.5 mm wide; adaxial surface with a moderately dense to dense stellate indumentum, becoming glabrous towards base; abaxial surface with a sparse to dense stellate indumentum. *Petals* 2.5–3.5 mm long, 1–1.25 mm wide; adaxial surface with a dense stellate indumentum, becoming glabrous towards base; abaxial surface with a moderately dense stellate indumentum. *Stamens* with filaments bearing stiff simple and bifid hairs abaxially and on margins below glandular tip; anthers glabrous, not apiculate, antepetalous anthers much larger than antesepalous anthers. *Ovary* glabrous; style pilose; stigma rounded, not or scarcely wider than style. *Cocci* glabrous or with a sparse indumentum, 3.5–4.5 mm long, 2.5–3.5 mm wide. *Seeds* shiny, black but mottled, 2.5–3.5 mm long, 1.5–2 mm wide; surface at magnification tuberculate; tuberculae smooth, unfused. (Figure 1)

Other specimens examined. WESTERN AUSTRALIA: Kimberley Region: 15 km N of junction of Youwanjela Creek and Prince Regent River, 15°36' S 125°29' E, 27 Jan. 2000, *M.D. Barrett* 925 (HO, PERTH); 15 km N of King Cascade on Prince Regent River, 15°29' S 125°19' E, 31 Jan. 2000, *M.D. Barrett* 1017 (HO, PERTH).

Distribution. *Boronia barrettiorum* is known from two populations c. 30 km apart and 15 km north of the Prince Regent River (Kimberley Region, W.A.). Additional material has been collected from Enid Falls, c. 5 km north-west of the collection locality of *Barrett* 1017 (M. Barrett pers. comm.).

Habitat and ecology. The species is found with *Triodia* spp. and bushy taxa (eg. species of *Ricinocarpos* and *Hibiscus* section *Furcaria*) in fire-protected places between rocks and large boulders on sandstone slopes (collector's notes).

Phenology. Flowering and fruiting material has been collected in January.



Figure 1. *Boronia barrettiorum* Duretto, holotype – Barrett 600 (PERTH 06347851) $\times 0.5$.

Conservation status. Collector's notes indicate that known populations of *B. barrettiorum* are small. *Barrett 1017* and *Barrett 600* were made from populations of less than 20 plants, and *Barrett 925* from a population of less than 40 plants. Conservation Codes for Western Australian Flora: Priority Two, given the small population sizes, the small number of known populations and their remote location.

Etymology. The epithet honours botanists Matt and Russell Barrett (Kings Park, Botanic Gardens and Parks Authority, W.A.) who were the first to collect this species. The two have added much to our knowledge of the Kimberley Region through their extensive collections in often remote areas.

Notes. *Boronia barrettiorum* appears to be most closely related to *B. pauciflora* with which it shares simple and ternate leaves. Lacking a rachis could be considered an apomorphy for these species. All other members of *Boronia* subseries *Filicifoliae* have imparipinnate leaves with a large number of small leaflets.

Boronia barrettiorum can be distinguished from *B. pauciflora* by having a moderately dense stellate indumentum on the leaves (*cf.* glabrous or glabrescent), and the hairs being evenly distributed around the young stems (*cf.* hairs, when present, being confined to, or denser in, the area between the decurrent leaf bases).

The eastern collections (*Barrett 600* & *Barrett 925*) of *B. barrettiorum* have stellate hairs which are much longer (rays to 0.5(–1.5) mm long) than the stellate hairs of the western collection (*Barrett 1017*; rays to 0.1 mm long). When alive, the eastern plants are dark green in colour whereas the western plants are a brighter green (M. Barrett, pers. comm.); this may be due to the presence of the shorter hairs on the western collections.

Boronia pauciflora demonstrates similar variation in hair size. Plants from south of the Prince Regent River, that is from the King Leopold Range (*Byrnes 2260* - CANB, DNA, PERTH; *Symon 7037* - HO, PERTH), Mount Broome (*Dureaus.n.* - PERTH 5449065, HO), Edkins Range (*Barrett 694* - HO, PERTH; *Telford 11627* - CANB, PERTH), and Camp Creek areas (*Kenneally 11654* - CANB, PERTH), have small hairs (rays to 0.1 mm long) while the collection from north of the river (*Craven et al. 9212* - CANB, MEL, PERTH) has large hairs (rays to 1.5 mm long).

This last collection is the only known collection of *B. pauciflora* from north of the Prince Regent River and is also the only collection which has trifoliolate leaves (Duretto 1997). The collection was made only c. 20 km from where *Barrett 1017* (with the short hairs) was collected. Apart from hair length, hair density on the branches also varies in *B. pauciflora*.

All collections have a moderately dense stellate indumentum on the branches except those from the Edkins Range area which are notable in that they have glabrescent branches. Sepal size is also variable. Variation has also been noted in *B. filicifolia* (see Wheeler 1992; Duretto 1997, 1999).

For the time being these differences in hair length *etc.* will not be used as the basis for segregation of additional taxa from *B. barrettiorum* and *B. pauciflora*. Collections from intervening areas and more detailed population surveys are required before these issues can be resolved.

Key to *Boronia* species found in the Kimberley Region, Western Australia

- 1. Plants glabrous (apart from petals and stamens); leaves 3–5-foliolate; leaflets linear, < 1 mm wide; sepals c. 1.25 mm long, < half the length of the petals **B. anomala**
- 1: Plants glabrescent or with a sparse to dense indumentum; leaves 1–55-foliolate; leaflet shape various, mostly > 1 mm wide; sepals 3.5–15 mm long, usually > half length of petals **2**
- 2. Leaves simple or ternate (rachis absent) **3**
- 2: Leaves 5–55-pinnate (rachis present) **5**
- 3. Leaflets linear; younger branches glandular tuberculate (also N.T.) **B. jucunda**
- 3: Leaves or leaflets lanceolate to ovate to elliptic; branches not obviously glandular **4**
- 4. Leaves glabrescent, 12–80 mm long **B. pauciflora**
- 4: Leaves with a moderately-dense indumentum [sometimes not clearly visible to the naked eye, though particularly noticeable on new foliage, at least on dry specimens, making them appear white], 8–30 mm long **B. barrettiorum**
- 5. Leaves with a moderately dense (epidermis visible) to dense (epidermis not visible) stellate indumentum; sepals (4–)5–15 mm long, larger than petals, abaxial surface with a dense indumentum; petals 3–10 mm long; anthopodium 3–6(–10) mm long **6**
- 5: Leaves glabrescent or with a sparse to moderately dense (epidermis visible) indumentum; sepals 3.5–6 mm long, smaller to slightly larger than petals, abaxial surface glabrous, glabrescent or with a sparse indumentum; petals 2.5–4.5 mm long; anthopodium 1–24 mm long **7**
- 6. Leaflets linear to narrowly elliptic, so revolute that abaxial surface not usually visible; sepals 5–14 mm long (E of Ord R.; also N.T. & Qld) **B. lanuginosa**
- 6: Leaflets elliptic to lanceolate, abaxial surface visible; sepals 5–9 mm long (W of Ord R.; also N.T.) **B. wilsonii**
- 7. Terminal leaflets 1–2 mm long, lateral leaflets 0.5–1.5 mm long; anthopodium 1–6 mm long **B. minutipinna**
- 7: Terminal leaflets (1.5–)3–11 mm long, lateral leaflets 0.5–5 mm long; anthopodium (2–)6–21 mm long **8**
- 8. At least some leaves with more than 30 leaflets present, (7–)30–75 mm long; leaflets elliptic to rhombic to circular; petiole 0–2 mm long; sepals 2–3.5 mm long, shorter to longer than petals **B. filicifolia**
- 8: Leaves with fewer than 30 leaflets (if greater than 30 leaflets then some petioles > 3 mm long), 8–40(–56) mm long; petiole 1–7 mm long; leaflets linear to elliptic; sepals 3.5–6 mm long, as long or longer than petals **B. kalumburuensis**

Note: Two simple-leaved taxa, *B. grandisepala* F.Muell. subsp. *grandisepala* and *B. lanceolata* F.Muell., have been collected near the Kimberley Region in the north-west of the Northern Territory, as has the previously mentioned *B. gravicocca*. Keys to separate these taxa from species known to occur in the Kimberley Region can be found in Duretto (1997, 1999, 2003).

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I would like to thank Matt and Russell Barrett (Kings Park, Botanic Gardens and Parks Authority, W.A.) for collecting, bringing to my attention and making available excellent material of *Boronia barrettiorum*; the directors of CANB, DNA and PERTH for lending material; Gintaras Kantvilas (HO) for checking the Latin diagnosis and reading an earlier draft of the manuscript; and Jean Jarman (HO) for assistance with Figure 1.

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Reinstatement of *Patersonia occidentalis* var. *angustifolia* and *Patersonia occidentalis* var. *latifolia* (Iridaceae)

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Abstract

Gibson, N. Reinstatement of *Patersonia occidentalis* var. *angustifolia* and *Patersonia occidentalis* var. *latifolia* (Iridaceae). *Nuytsia* 16(1): 21–27 (2006). *Patersonia occidentalis* R.Br. var. *angustifolia* Benth. and *Patersonia occidentalis* R.Br. var. *latifolia* (F.Muell.) Benth. are reinstated and a lectotype for *P. occidentalis* var. *angustifolia* is selected. Both *P. occidentalis* var. *angustifolia* and *P. occidentalis* var. *latifolia* are endemic to south-west Western Australia. *P. occidentalis* var. *angustifolia* occurs along drainage lines and in seasonal swamps while *P. occidentalis* var. *latifolia* occurs in drier habitats generally on clays or loams associated with laterite, granite or sandstone. The three varieties can be separated using a combination of leaf width, scape length and leaf aspect ratio.

Introduction

Since Brown (1810) named *Patersonia occidentalis* it has been recognised that the taxon encompasses significant morphological variation. Bentham (1873) recognised three varieties, two of which (var. *latifolia* and var. *angustifolia*) were synonymized by Geerinck (1974) and Cooke (1986), while the third (var. *eristophana* (F.Muell.) Benth.) is considered to be a synonym of the closely related *P. limbata* Endl. (Cooke 1986). While commenting on wide variation in morphological characters, Cooke (1986) was unable to differentiate any infraspecific taxa due to the continuous nature of the variation. During a regional quadrat-based flora survey of the southern Swan Coastal Plain (Gibson *et al.* 1994) a narrow leaf form of this taxon was noted to preferentially occur along creeklines and in swamps. This form was assigned the phrase name '*Patersonia* sp. Swamp form (N. Gibson & M. Lyons 544)' (Paczkowska & Chapman 2000). Subsequently, all *Patersonia occidentalis* material in HO, MEL and PERTH was examined to determine if this narrow leaf form warrants taxonomic recognition.

Materials and methods

In total 440 collections were examined including photos of the Brown syntypes from BM. For 316 of the collections there was sufficient material to measure leaf length, leaf width, scape length (to base of spathe), spathe length and spathe width. The longest leaf and largest flower of each collection was measured. The data was normalized and an association matrix based on Euclidean distance was calculated. This matrix was ordinated using non-metric multi-dimensional scaling (MDS), and analysis of similarity (ANOSIM) was used to test differences in rank association between presumed taxa. All analyses being undertaken in Primer Ver. 6.1.5 (Clarke & Gorley 2006). Leaf aspect ratio (leaf length/leaf width) was subsequently calculated and compared between the presumed taxa.

Results

The ordination confirmed wide and continuous variation in leaf and flower characters in *Patersonia occidentalis* with no clear separation of any groups in the ordination space. Examination of the all relevant type material suggested that two of the varieties named by Bentham (var. *angustifolia* and var. *latifolia*) fell at the extremes of the ordination space. He discriminated these taxa primarily on leaf width but examination of types showed that syntypes of var. *angustifolia* also had consistently longer scapes and an isotype of var. *latifolia* (Oldfield, MEL 40536) had a short scape.

The collections were divided into three groups. Group 1 – with narrow leaves (<5.5 mm) and long scapes (>750 mm) and included the syntypes of var. *angustifolia*; group 2 – those with short scapes (<750 mm) and wide leaves (>7 mm) and included the isotype of var. *latifolia*, and the remainder (group 3) with leaf widths <7 mm and scapes of <750 mm and included all other available type material. (Figure 1)

A one-way ANOSIM analysis was used on the association matrix to test if significant differences in rank similarity did occur between these three groups. This procedure determined significance by Monto-Carlo permutation of the original association matrix (Clarke & Gorley 2006).

Significance differences were found between the three groups (Global $R=0.549$, $P<0.001$) and pairwise tests showed highly significant differences between all three groups (group 1 v groups 2, $R=0.950$, $P<0.001$; group 1 v group 3, $R=0.678$, $P<0.001$; groups 2 and 3 $R=0.457$, $P<0.001$). Leaf aspect ratio was also highly significantly different between the groups (95% confidence intervals were: group 1, 170.4 – 242.9; group 2, 41.6 – 53.1; group 3, 93.2 – 104.5).

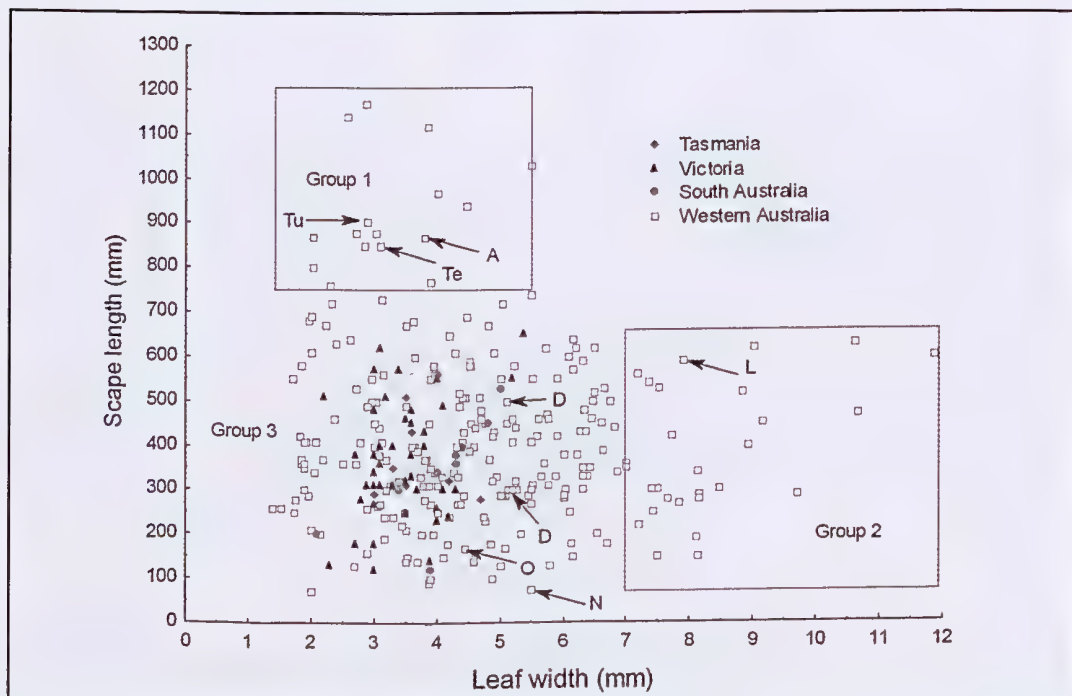


Figure 1. Plot leaf width against scape length for 316 collections. Collections from Tasmania (◆); Victoria (▲); South Australia (●); Western Australia (□). The three groups of collections corresponding to Bentham's varietal classification are shown. Type material arrowed: A – lectotype *P. occidentalis* var. *angustifolia* (MEL 40598); D – syntypes *P. diesingii* (MEL 40592, MEL 40593); L – isotype *P. occidentalis* var. *latifolia* (MEL 40536); N – lectotype *P. nana* (MEL 40595); O – lectotype *P. occidentalis* var. *occidentalis* (BM 5613); Te – isolectotype *P. tenuispatha* (MEL 40597); Tu – isolectotype *P. turfosa* (MEL 40596).

Discussion

While there are no clearly distinct morphological groupings within *Patersonia occidentalis* the multivariate analysis supports the reinstatement of both *P. occidentalis* var. *angustifolia* and *P. occidentalis* var. *latifolia* as leaf, scape and spathe characters shows consistent differences from each other and the typical form. Given the gradational changes in all characters measured, varietal rank is considered to be appropriate.

Both *P. occidentalis* var. *angustifolia* and *P. occidentalis* var. *latifolia* are restricted to south-west Western Australia (Figure 1). *P. occidentalis* var. *angustifolia* is apparently confined to streamlines and swamps. In Western Australia *P. occidentalis* var. *occidentalis* occurs widely across the landscape in both upland and wetland situations, while *P. occidentalis* var. *latifolia* is generally found in drier habitats.

The original collection designated as '*Patersonia* sp. Swamp form (N. Gibson & M. Lyons 544)' has a short scape and is best considered a narrow leaf form of *P. occidentalis* var. *occidentalis*.

Taxonomy

Patersonia occidentalis R.Br., *Prodr.* 304 (1810). *Type*: Bay I [Lucky Bay], South Coast [Western Australia], Jan. 1802, *R. Brown* (*lecto*: BM 5613 in part, *fide* D. Geerinck, *op. cit.* 52; *lectopara*: BM 5613 left hand element, BM 5614, BM 5615).

Distribution. South-west Western Australia from south of Shark Bay to Israelite Bay, in south-east South Australia, Victoria and northern and eastern Tasmania (Cooke 1986).

Notes. Three intergrading varieties can be recognized based on leaf width, scape length and leaf aspect ratio.

Patersonia occidentalis* R.Br. var. *occidentalis

Patersonia longiscapa Sims ex Sweet, *Fl. Australasica* t. 39 (1828). *Type*: cultivated in England from seed collected from south coast of Australia by W. Baxter, *n.v.* While no type material has been found the illustration and description in Sweet *op. cit.* clearly falls within the circumscription of *P. occidentalis* var. *occidentalis*.

Patersonia sapphirina Lindley, *Edw. Bot. Reg.* 25: t. 60 (1839). *Type*: cultivated in England from seed obtained by Mangles, *n.v.* The lack of type material and the absence of a scale on the illustration in Lindley *op. cit.* make it difficult to definitively assign this material.

Patersonia diesingii Endl. in J.G.C. Lehmann, *Pl. Preiss.* 2: 30 (1846). *Type*: Perth [Western Australia], 16 July 1839, *Preiss* 2356 (*lecto*: S, *n.v.*, *fide* D. Geerinck, *op. cit.* 51; *isolecto*: FI, *n.v.*, *fide* D. Geerinck *op. cit.* 51, !MEL 40593, !MEL 40592, P *n.v.*, *fide* D. Geerinck *op. cit.* 51).

Patersonia flaccida Endl. in J.G.C. Lehmann, *Pl. Preiss.* 2: 30 (1846). *Type*: In solo fertili planitie prope fluvium Saltrive [Salt River], York, 26 Mar. 1840, *Preiss* 2355 (*lecto*: BR, *n.v.*, *fide* D. Geerinck *op. cit.* 51).

Patersoniana nana Endl. in J.G.C. Lehmann, *Pl. Preiss.* 2: 30 (1846). *Type*: In arenosis ad Stirling's-terrace, Plantagenet, 23 Sept. 1840, *Preiss* 2346 (*lecto*: !MEL 40595, *fide* D. Geerinck *op. cit.* 52).

Patersonia occidentalis var. *aemulans* Domin, *J. Linn. Soc. Bot.* 41: 254 (1912). *Type*: Slab Hut Gully on way to Cranbrook [Western Australia], 1909, *Dorrien-Smith*; *holo*: K, n.v., *fide* Domin *op. cit.*

Tufted herb. Leaves ensiform, 10–90 cm long, 1.5–7.0 mm wide, finely veined, glabrous, leaf aspect ratio (25–) 93–105 (–345): 1. Scape 7–74 cm, glabrous. Spathes elliptic, 28–56 (–70) mm long, 3.7–14.9 mm wide in flower, glabrous.

Selected specimens examined. WESTERN AUSTRALIA: Boulder Hill, Two Peoples Bay, 6 Oct. 1992, A.R. Annels 2612 (PERTH); Nannup, 10 June 1996, R. Davis 1161 (PERTH); N of Thistle Cove, E of Esperance, 21 Jan. 1966, A.S. George 7530 (PERTH); Fitzgerald River below Roes Rock, 18 Dec. 1970, A.S. George 10528 (PERTH); Scott National Park, 9 Apr. 1990, N. Gibson & M. Lyons 218 (PERTH); Wheatbelt, Ronnerup Lake (Reserve 39422), 22 Nov. 1994, M. Graham G204-20 (PERTH); Hi Vallee property, Warradarge, 23 Oct. 1999, M. Hislop 1707 (PERTH); 19.7 km S of Northcliffe on Windy Harbour Rd, 10 Jan. 1995, E.D. Kabay 1359 (PERTH); Lowlands property, 8 km WNW of Serpentine, 13 Sep. 1992, B.J. Keighery & N. Gibson 825 (PERTH); North Jindong Road, c. 2 km S of Bussell Highway, 15 Oct. 1992, B.J. Keighery & N. Gibson 1077 (PERTH); 60.4 km W along State Barrier Fence Access from NW Coastal Highway, 26 Aug. 1994, G.J. Keighery & N. Gibson 1512 (PERTH); Kodjup Nature Reserve, 21 Oct. 1997, G.J. Keighery & N. Gibson 2738 (PERTH); 3 km S of Mount Barker, 25 Oct. 1977, K.F. Kenneally 6500 (PERTH); c. 3.3 km S of Tambellup, 1998, F. Obbens 359/98 (PERTH); Beverley Airfield Reserve, 10 Oct. 2000, M. Ochtman 442 (PERTH); Carousel Swamp, opposite Cannington Station, 3 Oct. 1996, L.W. Sage 786B (PERTH); 4 km south of Hutt R along NW coastal highway, 31 Aug. 1982, P.S. Short 1600 (MEL); McKenzie Rd, W of Narrogin town, 29 Oct. 2002, G. Warren & P. Rose 685 (PERTH). SOUTH AUSTRALIA: Lofty Ranges, Dec. 1851 (MEL); c. 8 km NE of Myponga, 5 Dec. 1977, N.N. Donner 5975 (HO); Swamps near Mt Benson, 1895, Dr Engelharts.n. (MEL); Square waterhole c. 3 km S of Mt Compass, 3 Apr. 1974, E.N.S. Jackson 2465 (MEL); Onkaparinga River, Dec. 1898, Mueller (MEL); St Vincents Gulf/Lofty Ranges, Mueller (MEL); Clarendon, 6 Nov. 1881, O. Tepper 261 (MEL); Clarendon, Swampy Creek, 6 Nov. 1881, O. Tepper 262 (MEL); Forest Reserve, Knott Hill, 15 Jan. 1985, H.P. Vonow 358 (HO). VICTORIA: Frankston to Skye, 7 Nov. 1901 (MEL); near Mt Abrupt, Grampians (MEL); Lower Glenelg R area, Kentbrush heathland, N of Mt Kincaid, 2 Nov. 1968, A.C. Beaglehole 29378 (MEL); Nooramung Wildlife Res, Snake Is, 25 km SSW Yarram, 5 Dec. 1978, A.C. Beaglehole s.n. (MEL); Grampians, Jimmy's Creek area, 26 km S of Halls Gap PO, 6 Dec. 1979, A.C. Beaglehole 66936 (MEL); Kargenon Flora Reserve, 7 Nov. 1982, A.C. Beaglehole 71174 & L.K. Melmore (MEL); Mirranalwa Gap, Grampians, 20 Nov. 1972, B. Conn s.n. (MEL); Boronia Primary School Flora Res., 29 Nov. 1986, B.J. Conn 2560 (MEL); Otway Region, Great Ocean Rd, 5.5 km from Apollo Bay, 9 May 1983, G.E. Earl 201 & D.M. Parkes (MEL); Emerald, Nov. 1904, J.P. McLennan s.n. (MEL); Port Phillip, Mueller s.n. (MEL); Port Phillip, Victoria, Mueller (HO); Wilson's Promontory, Norman Point, 15 Dec. 1958, T.B. Muir 625 (MEL); On the Frankston-Cranbourne Rd, 4 miles from Cranbourne, 9 Nov. 1961, T.B. Muir 2507 (MEL); Gippsland, E of Andersons Inlet, 5 m from Tarwin Lower, 14 Oct. 1961, T.B. Muir 2357 (MEL); On Kirkpatrick Rd, c. 2 km N of Maclesfield, 20 May 1977, A.M. Opie, A.B. Wellington, R.A. Hosks.n. (MEL); Grampians, 26 Apr. 1986, S.T.W. Partett 91 (MEL); Oberon Bay Swamp, Wilsons Promontory, 14 Nov. 1908, A. St John s.n. (MEL). TASMANIA: West Tamar, c. 5 miles from Greens Beach (HO); E of Hardwich Hill, 24 Nov. 1984, A.M. Buchanan 1780 (HO); Low Head, Georgetown, Dec. 55, W.M. Curtis (HO); New communications tower, Waterhouse, 18 Nov. 1975, D.I. Morris (HO); 1 km SW of Cape Naturaliste, 13 Oct. 1983, A. Moscal 3432 (HO); Near One Tree Hill, 21 Nov. 1983, A. Moscal 4261 (HO); 2 km E of Croppies Point, 24 Nov. 1983, A. Moscal 4420 (HO); Black Rock Pt, 26 Nov. 1983, A. Moscal 4488 (HO); Kelso, 2 Dec. 1975, M. Thompson (HO).

Distribution and habitat. Widespread and common in south-west Western Australia but largely absent from the Avon-Wheatbelt and northern Mallee bioregions. Also occurring in South Australia, Victoria and Tasmania. Occurs most commonly in woodlands and shrublands on a variety of soil types, but also recorded from the edge of seasonal wetlands.

Conservation status. Common and well conserved.

Notes. Differs from var. *angustifolia* by its shorter scape and lower leaf aspect ratio (generally 93–105 : 1). Differs from var. *latifolia* by its narrower leaves and higher leaf aspect ratio.

Patersonia occidentalis R.Br. var. ***angustifolia*** Benth., *Fl. Austral.* 6, 403 (1873). *Type:* Murchison River [Western Australia], *Oldfield* (*lecto*, here designated: MEL 40598. *Other material:* [Western Australia] *Preiss* 2358 (cited in error by Benthham as 2338), *lectopara:* !MEL 40596, !MEL 40597, P (two sheets), S).

Patersonia tenuispatha Endl. in J.G.C. Lehmann, *Pl. Preiss.* 2, 31 (1846). *Type:* near Whitefield station, York [Western Australia], 15 Mar. 1840, *Preiss* 2358 p.p. (*lecto:* P, *n.v.*, *fide* D. Geerinck *op. cit.* 51; *isolecto:* !MEL 40597).

Patersonia turfosa Endl. in J.G.C. Lehmann, *Pl. Preiss.* 2, 31 (1846). *Type:* Mt. Eliza, Perth [Western Australia], 21 Jan. 1839, *Preiss* 2358 p.p. (*lecto:* S, *n.v.*, *fide* D. Geerinck *op. cit.* 51; *isolecto:* !MEL 40596, P, *n.v.*, *fide* D. Geerinck *op. cit.* 51).

Tufted herb. Leaves ensiform, 42–105 cm long, 2.0–5.5 mm wide, finely veined glabrous, leaf aspect ratio (105–) 170–243 (–352) : 1. Scape 76–120 cm, glabrous. Spathes elliptic, 30–53 mm long, 5.5–11.4 mm wide in flower, glabrous.

Specimens examined. WESTERN AUSTRALIA: Lower Shannon Bridge on Preston Road, 21 Nov. 1994, A.R. Annels 4968 & R.W. Hearn (PERTH); E of Bibra Lake, Nov. 1979, P. Bridgewater s.n. (PERTH); S side of Fishermen Rd, 6.9 km by road SE of beach at Broke Inlet, 21 Nov. 1990, N. Gibson & M. Lyons 852 (PERTH); Harry Waring Marsupial Reserve, S of Thomsons Lake Nature Reserve, 9 Oct. 1992, N. Gibson & M. Lyons 1494 (PERTH); Ralph Rd, Pemberton, near Warren National Park, 21 Nov. 1993, Graham 2143 (PERTH); Wonnerup Road reserve, 8 km ESE from the Bussell Hwy, 16 km E of Busselton, 16 Oct. 1992, B.J. Keighery & N. Gibson 827 (PERTH); Along Bambun Road, c. 0.5 km from Highway, 7.5 km S of Gingin, 16 Nov. 1992, B.J. Keighery & N. Gibson 1078 (PERTH); Yallingup Siding near Busselton, 15 Oct. 1992, B.J. Keighery & N. Gibson 1079 (PERTH); Lowlands property near SW boundary, c. 9 km WNW of Serpentine, 6 Nov. 1993, B.J. Keighery & N. Gibson 1123 (PERTH); Near corner of Fawcett and Bulla Rds, 3 km SW of Waroona, 29 Sep. 1990, B.J. Keighery & N. Gibson 1151 (PERTH); c. 18 km NW of Pemberton, Nelson Location 5049, 28 Dec. 1981, T.D. Macfarlane 729 (PERTH); South of Swan River, in Darling Ranges, Nov. 1877, Mueller (MEL); *Preiss* 2358 (MEL); Between Moates Lake and Gardner Lake, Two Peoples Bay Nature Reserve, 21 Oct. 1975, G.T. Smith & L.A. Moore s.n. (PERTH).

Distribution and habitat. Endemic to south-west Western Australia from the Murchison River to Two People's Bay east of Albany, associated with seasonal wetlands or drainage lines. Except for the Oldfield collection (MEL 40598), all recent collections occur between Perth and Two Peoples Bay. The Oldfield locality may be in error.

Conservation status. Not well collected but likely to be overlooked, not considered threatened.

Notes. Differs from typical variety by a longer scapes (>750 mm) and high leaf aspect ratio (generally 17 : 243 : 1). Differs from var. *latifolia* by its narrower leaves (<7 mm) and long scapes.

Lectotypification. The lectotype selected (*Oldfield*, Murchison River, MEL 40598) was the most complete of the available type material in MEL. While not marked as seen by Bentham, a search of E and K failed to find any duplicates of this collection.

Patersonia occidentalis* var. *latifolia (F. Muell.) Benth., *Fl. Austral.* 6: 403 (1873). *Type:* Champion Bay [Western Australia], *Oldfield* (holo: K, n.v., fide D. Geerinck, *op. cit.* 51; iso: !MEL 40536).

Tufted herb. *Leaves* ensiform, 20–66 cm long, 7–12 mm wide, finely veined glabrous, leaf aspect ratio (25–)42–53 (–91): 1. *Scapes* 15–63 cm, glabrous. *Spathes* elliptic, 31–54 mm long, 5.2–14.1 mm wide in flower, glabrous.

Selected specimens examined (all PERTH). WESTERN AUSTRALIA: Red Bluff, S of Murchison River mouth, 27 Sept. 1962, J.S. Beard 2028; Jarrahdale, Aug. 1939, W.E. Blackall s.n.; Commonage Road, 4 Dec. 1996, N. Casson & T. Annels SC 33.13; Kalbarri National Park, 11 Oct. 1986, R.S. Cowan A 276; 19 km N Muirs Highway, 18 Feb. 1998, R. Davis 6029; 6.6 km N Brookton Highway, 22 Mar. 2001, R. Davis 958; on Dwarlaking Road, 26 Oct. 2000, R. Davis WW 34-40; Mt Lesueur, 12 Oct. 1957, C.A. Gardner s.n.; Botolph Harbour, 26 Nov. 1990, N. Gibson & M. Lyons 923; Kalbarri National Park, 3 Oct. 1991, W. Greuter 2250; Stirling Range National Park, 23 Oct. 1991, W. Greuter 23124; 10 km SW of Lake Indoon, 14 Sept. 1977, R. Hnatiuk 770987; Port Gregory Rd, 27 Sept. 1985, N. Hoyle 465; c. 32.9 km S of Northampton, 22 Aug. 1983, C.M. Lynch 82; Kalamunda National Park, 1 Nov. 2000, K. Macey 266; 2.3 km SE of North Bannister, 3 Jan. 1982, T.D. Macfarlane 741; Armadale Settlers Common, 14 Oct. 1996, A. Markey 36; Byford Regional Open Space, 19 Oct. 1996, A. Markey 348; Ellis Brook Valley, 10 Dec. 1996, A. Markey 583; Kingston Block, 6 Oct. 1998, E.D. Middleton K 157; off Trigwell Bridge Rd, 12 Aug. 1997, G. Paull 1593; c. 22.5 miles from Dongara toward Eneabba, 22 Sept. 1972, M.E. Phillips s.n.

Distribution and habitat. Endemic to south-west Western Australia from south of Shark Bay to the Stirling Range, generally on upland areas or drier slopes with clay or loam soils associated with laterite granite or sandstone but has also been recorded from growing on sand.

Conservation status. Not well collected but likely to be overlooked, not considered threatened.

Notes. Differs from both the typical variety and var. *angustifolia* by its wider leaves (>7 mm) and low leaf aspect ratio (generally 42–53 : 1).

Acknowledgements

Assistance was provided by ABLO officers P. Short, P. Weston and A. Wilson in supplying photos of the Brown syntypes and checking collections at BM and K, and J. Ross rechecked type material held in MEL. Managers of HO, MEL and PERTH allowed access to their collections. Paul Wilson and an anonymous referee offered valuable comments on an earlier draft.

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Contributions to Western Australian orchidology: 3. New and reinstated taxa in *Eriochilus*

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Abstract

Hopper, S.D. & Brown, A.P. Contributions to Western Australian Orchidology: 3. New and reinstated taxa in *Eriochilus* Nuytsia 16(1):29–61 (2006). The systematics of Western Australian members of Brown's (1810) genus *Eriochilus* R.Br. has been controversial, confused and poorly understood. This paper provides a revision drawing upon recent fieldwork, collections and herbarium studies that considerably resolve the taxonomic situation. We describe the following taxa as new: *E. helonomos*, *E. pulchellus*, *E. valens*, *E. dilatatus* subsp. *magnus*, *E. dilatatus* subsp. *orientalis*, *E. dilatatus* subsp. *undulatus*, and *E. scaber* subsp. *orbifolia*. New combinations are *E. dilatatus* Lindley subsp. *multiflorus* (Lindley) Hopper and A.P. Br. and *E. dilatatus* Lindley subsp. *brevifolius* (Benth.) Hopper and A.P. Br. The genus is thus enlarged in Western Australia to 6 species. *E. dilatatus* is geographically variable, now with six subspecies. *E. scaber* subsp. *orbifolia* is the only threatened taxon in Western Australia, known from a single locality near Walpole.

Introduction

Eriochilus is an endemic Australian genus of terrestrial geophytic orchids comprising at least eight species, commonly known as bunny orchids. Six of the eight named species are endemic to Western Australia, the other two *Eriochilus* being south-east Australian.

Eriochilus was first described by Brown (1810), who placed it near *Caladenia* and *Glossodia*. It has remained in use as a genus ever since, but its relationships to other genera of Australasian Diurideae have been less certain. Prior to molecular studies, a consensus among most independent workers had been reached that *Eriochilus* was best placed in the subtribe Caladeniinae, together with a number of other genera, including *Adenochilus*, *Burnettia*, *Caladenia sens. lat.*, *Elythranthera*, *Glossodia*, and *Lyperanthus* (Pfitzer 1889; Schlechter 1926; Lavarack 1976; Dressler 1981, 1993; Burns-Balogh and Funk 1986; Clements 1995; Szlachetko 1995).

Molecular studies have progressively improved understanding of the generic relationships of *Eriochilus*. Kores *et al.* (1997) using plastid *rbcL* sequences, found a strongly supported clade comprising *Eriochilus* sister to *Caladenia/Glossodia*. Subsequently, a single ITS tree published by Clements and Jones (2002) and Clements *et al.* (2002) was used to segregate *Eriochilus* from Caladeniinae in the new subtribe Eriochilidinae. However, both the ITS and plastid sequence studies of Kores *et al.* (2001, Kores

et al. in Hopper and Brown 2001), as well as a combined *matK* and ITS analysis of Caladeniinae (P. Kores, M. Molvray pers. comm.), showed, in strict consensus trees, that *Eriochilus* was embedded with strong bootstrap support in the subtribe between *Adenochilus* and all other genera. On this evidence, Hopper and Brown (2004) choose to leave *Eriochilus* in Caladeniinae as traditionally placed.

With the exception of *Caladenia* subgenus *Drakonorchis*, *Eriochilus* differs from other Caladeniinae in its hairy labellum. *Eriochilus* has a claw that is closely appressed to the column and about the same length as the labellum lamina. *Eriochilus* is unique within the subtribe in its pollinia that are divaricated, almost contracted into caudicles. It also differs from all other genera (except *Leptoceras*) in its naked tuber, not enclosed in the upper half by a persistent shaggy fibrous sheath (tunica).

The systematics of Western Australian members of Brown's (1810) genus *Eriochilus* has been controversial, confused and poorly understood. Lindley's (1840) description of five species endemic to W.A. was a major contribution, although based on limited material primarily collected by James Drummond. Subsequent authors have treated Lindley's species in many different ways (Endlicher 1846; Reichenbach 1871; Benth 1873; Rogers 1920; Pelloe 1930; Erickson 1965; Nicholls 1969; George 1971; Hoffman and Brown 1984; Green 1985; Jones 1988; Clements 1982, 1989).

While collections in herbaria have steadily improved over the past 200 years, the above authors were not able to invest sufficient time in the field to develop an adequate understanding of population variation in fresh material. Consequently, there are disagreements as to the status of Lindley's (1840) five species, and the existence of several undescribed taxa has been overlooked. Here, we clarify the status of Lindley's species and describe seven new taxa on the basis of extensive field surveys, and an examination of herbarium collections.

We understand that new taxa have been identified in eastern Australia as well, and will be described elsewhere (Bates 1989; Bates and Weber 1990; Jones and Clements 2004, pers. comm.). Jones and Clements (2004) have recently described *Eriochilus petricola* as a necessary new name for *E. autumnalis* R.Br., the latter "rendered invalid when, in the original publication, Brown listed *Epipactis cucullata* Labill. (= *Eriochilus cucullatus* (Labill.) Reeb.f.) as a synonym."

An amended generic description and key to species in Western Australia is provided here before all Western Australian species and subspecies known to us are described.

Taxonomy

***Eriochilus* R. Br., Prod. 323 (1810).** *Type* (here selected): *Eriochilus cucullatus* R. Br. [*Eriochilus autumnalis* R.Br. *nom. illeg.*, *fide* Jones & Clements 2004.]

Illustrations. *Eriochilus* R. Br., Prod. 323 (1810); Lindley, Gen. sp. orch. pl. 426 (1840); Lindley, Sketch Veg. Swan Riv. Col. 53 (1840); Endl. in Lehm., Pl. Preiss. 2: 10 (1846); Reichb. f., Beitr. Syst. Pfl. 27, 62 (1871); Benth., Fl. Aust. 6: 371 (1873); E. Pelloe, *West Australian Orchids* 39–40 (1930); H.M.R. Rupp, *Orchids of New South Wales*, 52–53 (1943); Blackall & Grieve, *How to Know Western Australian Wildflowers*, Part 1, 91 (1954); R. Erickson, *Orchids of the West*, 61–63 (1965); Nicholls, *Orchids of Australia* 53 (1969); Cady & Rotherham, *Australian Native Orchids in Colour* 54–55 (1970); A.S. George, *A checklist of the Orchidaceae of Western Australia* Nuytsia 1: 181 (1971); Pocock, *Ground Orchids of Australia* 35–36

(1972); J. Weber & R. Bates, Orchidaceae. In Jessop, J.P. & Toelken, H.R. (eds.). *Flora of South Australia*. Part I, Third Edition, 417–418 (1978), & Part IV, Fourth Edition, 2090–2091 (1986); M. Clements, *Preliminary checklist of Australian Orchidaceae* 106–107 (1982); N. Hoffman & A. Brown, *Orchids of South-West Australia*, 1st ed., 348–353 (1984); W.R. Elliot & D.L. Jones, *Encyclopedia of Australian Plants Suitable for cultivation Vol. 3*, 469–470 (1984); C. Woolcock & D. Woolcock, *Australian Terrestrial Orchids*, 6–7 (1984); D.L. Jones, *Native Orchids of Australia*, 157–160 (1988); M.A. Clements, *Catalogue of Australian Orchidaceae. Australian Orchid Research* 1, 77–78 (1989); M. Hodgson & R. Paine, *Field Guide to Australian Orchids*, 151–152 (1989); R. Bates & J. Weber, *Orchids of South Australia*, 88–89 (1990); N. Hoffman & A. Brown, *Orchids of South-West Australia*, 2nd ed., 177–188 (1992) and rev. 2nd edn with suppl., 177–188 (1998); G. Backhouse & J. Jeanes, *The Orchids of Victoria*, 185–186 (1995); T. Bishop, *Field Guide to the Orchids of New South Wales and Victoria*, 163–164 (1996); D. Jones, H. Wapstra, P. Tonelli & S. Harris, *The Orchids of Tasmania*, 145–146 (1999); D. & B. Jones, *A Field Guide to the Native Orchids of Southern Australia*, 137–139 (2000); J.J. Riley & D.P. Banks, *Orchids of Australia*, 152–155 (2002).

Perennial geophytic herbs. *Root tuber* annually replaced, daughter tuber produced off a short root-like stolon adjacent to parent tuber forming an unequal pair; tuber globose, white, fleshy, naked, not enclosed in upper half by a persistent shaggy fibrous sheath (tunica). *Leaf* solitary, larger and fully expanded on nonflowering plants and in unburnt communities, partly or fully developed at anthesis, basal and sessile or on a long ensheathing petiole with a cauline lamina; *lamina* fleshy to subcoriaceous, flat to cupped, orbicular–ovate to navicular; usually horizontal to semi-erect, discolorous, green above, sometimes with paler linear or reticulate nerves, paler green or dark maroon below, glabrous or sparsely hirsute with patent eglandular trichomes to 2 mm long. *Scape* wiry or rarely somewhat fleshy, stiff, sparingly hirsute with simple patent trichomes lacking an enlarged basal cell, *cauline bracts* absent; *floral bract* solitary, shortly ensheathing the pedicel and base of ovary, erect, foliaceous, obtuse, sparsely hirsute externally. *Inflorescence* erect, terminal, solitary, single or many flowered in a loose raceme or panicle. *Flowers* sometimes scented, nectar-producing or nectarless, generally cream to pink, sometimes with dark maroon markings, sessile or on sparsely hirsute short pedicels <5 mm long. *Perianth* variously hirsute, eglandular, remaining fully opened irrespective of temperature after anthesis, not glossy above. *Sepals and petals* (excluding labellum) dissimilar, not glossy above, lacking spots below, short, not long-acuminate, usually with sparse short hairs on the abaxial surface. *Dorsal sepal* incurved over the column and narrower than lateral sepals, with darker incurved margins. *Lateral sepals* free, flat, usually spreading, wider than the dorsal sepal and petals, uniformly coloured. *Petals* usually spreading (rarely erect against column), equal in length or shorter than labellum when flattened, narrower than lateral sepals, with darker incurved margins and apices. *Labellum* hirsute, lacking calli, stiffly hinged by an elongate claw same length as lamina, attached to the anterior column base, with difficulty pushed away from column and springing back to original appressed position on release; *lamina* undivided or 3-lobed with very small erect lateral lobes, linguiform; large middle lobe ovate, strongly convex, recurved up to 360°, convex in lateral cross section at widest point, with a median basal usually glabrous channel, sometimes extended longitudinally towards the apex, margins incurved, entire, hirsute; hairs many, small, few-celled; claw to 4 mm long. *Column* erect to obliquely ascending, straight, narrow, thickening in lateral view from the base to the stigma, lacking a horn-like apical mucro, slenderly winged. *Anther* not terminating in a definite point. *Pollinia* eight, divaricated, almost contracted into caudicles, lamillate, yellow. *Stigma* wider than high, transversely ovate to variously convoluted, lacking an acute apex. *Ovary* sparsely covered with fine patent trichomes.

Notes. *Eriochilus* is a genus of at least eight species, possibly up to 12. Six are endemic in Western Australia and at least two in the eastern States. The eastern Australian taxa are currently under review (Jones and Clements 2004, pers. comm.).

Pridgeon (1994), in a limited sample of specimens and taxa, found that leaf anatomical features supported the retention of *Eriochilus*. Within the genus, he noted that “*Eriochilus scaber* differs from *E. autumnalis* (= *Eriochilus petricola*) and *E. multiflorus* in having papillae instead of multicellular, eglandular trichomes and in stomata that are different in size and shape.” He did not extrapolate from this conclusion to a taxonomic recommendation, and our research similarly does not attempt a formal infrageneric treatment in view of the need for further basic research at species level across Australia.

Until this is done, it will be difficult to determine affinities of all the new W.A. taxa described below and distinguished in the following key.

The six species of *Eriochilus* endemic to Western Australia are distinguished in the following key.

Key to Western Australian species of *Eriochilus*

1. Leaf basal on flowering plants 2
2. Scape glabrous, usually taller than 10 cm; leaf uniformly green
on non-flowering plants; flowers Sept.–Nov. *E. tenuis*
- 2: Scape hirsute, usually less than 10 cm; leaf striped above and
red beneath on non-flowering plants; flowers July–early Oct. *E. scaber*
- 1: Leaf cauline, inserted a quarter to half way up flowering scape 3
3. Scape often solitary-flowered (rarely 2–5), less than 20 cm tall;
leaf usually ovate, usually less than 15 mm long (rarely to 20 mm),
not prominently ribbed beneath when fresh on flowering plants at anthesis 4
4. Leaf apex acuminate acute, margins often undulate; labellum 2–4 mm wide,
with scattered clusters of dark red or opaque hairs; flowering not
dependent on fire; confined to winter-wet swamps and granite rocks
from Cataby to Cape Riche *E. helonomos*
- 4: Leaf apex shortly acute, margins flat or slightly undulate; labellum
3–6 mm wide, with a central longitudinal channel and green band
conspicuously devoid of coloured hairs, flanked by dense clusters of
dark red hairs; flowering dependent on summer fire; confined to margins
of winter-wet swamps in the Albany–Walpole–Manjimup area *E. valens*
- 3: Scape usually 3–7-flowered (sometimes 1, 2, to 20+), 5–50 cm tall;
leaf ovate–navicular, 10–105 mm long, prominently ribbed beneath
when fresh on flowering plants at anthesis 5
5. Leaf fleshy, 14–20 mm long; scape fleshy, 3–15 cm tall, 3–5-flowered
(rarely 1–2, or 6–11); flowers with dark red markings; flowering not
stimulated by fire; confined to moss swards on granite or rarely
limestone; disjunct in the Northcliffe–Albany, Perth and
Esperance–Balladonia areas *E. pulchellus*
- 5: Leaf thin, 10–105 mm long; scape wiry, usually 10–60 cm tall,
usually 4–15-flowered; flowers with pale purple markings;
flowering often stimulated by fire; widespread in various
habitats from Shark Bay to Israelite Bay *E. dilatatus*

Eriochilus dilatatus Lindley, Sketch Veg. Swan Riv. Col. 53 (1840). Type: Swan River, *J. Mangles s.n.* (holo: K-L!).

See under subspecies for synonyms.

Leaf cauline, not fleshy, glabrous, ovate-navicular, 1.0–10.5 cm long, prominently ribbed beneath when fresh on flowering plants at anthesis; apex shortly acute; margins flat or undulate. *Leaf of non-flowering plant* 3.0–10.5 cm \times 0.5–3.5 cm. *Leaf of flowering plant* inserted a quarter to half way up scape, usually smaller than on non-flowering plant, 1.5–7.5 cm \times 0.5–1.5 cm. *Scape* wiry, uniformly green, to 60 cm tall. *Floral bract* narrowly ovate, to 5 \times 2 mm. *Inflorescence* usually 4–15-flowered. *Dorsal sepal* cream with brownish-red marginal markings, 5–10 mm \times 2–4 mm. *Lateral sepals* cream, 7–20 mm \times 2.5–4 mm. *Petals* obliquely ascending away from column at full anthesis, with brownish-red marginal longitudinal stripes, 5–8 mm \times 0.5–1.5 mm. *Labellum* 6–11 mm long \times 3–5 mm wide; *lamina* 3–7 mm long \times 3–5 mm wide, prominently decurved, flattened-orbicular when viewed from front, with a central longitudinal channel, greenish cream, with scattered clusters of creamy to pale purple hairs; *claw* 3–5 mm long. *Column* 5–7 mm \times 2–3 mm; stem uniformly pale green, tapering slightly towards base. *Anther* greenish yellow with red markings near the margins. *Stigma* clearly visible through a transversely oval orifice; margins of orifice greenish yellow, becoming dark red; upper and lower margins with a central downward dip. *Ovary* green. (Figure 1)

Distribution and habitat. WESTERN AUSTRALIA: Ranges widely from Dirk Hartog Island in Shark Bay south-east to Toolinna Cove, and extends inland to near Merredin. Grows in a broad range of communities and soil types, from coastal limestone outcrops to granitic rocks inland.

Flowering period. March to June, some subspecies stimulated by summer fire.

Notes. This is the most common and widespread species of *Eriochilus* in southwest Australia. It is variable in leaf morphology and the number of flowers in the scape. *E. dilatatus* differs from *E. pulchellus* in its thinner leaves and scapes; its paler coloured flowers; and its widespread occurrence in forests and shrublands, rather than being confined only to granite outcrops. When *E. dilatatus* grows on granite outcrops in forest areas it favours shaded sites rather than being exposed to full sun whereas *E. pulchellus* grows in full sun. *E. helonomos* has similar flowers to *E. dilatatus*, but differs in its shortly ovate acute leaf and in usually being solitary-flowered. *E. valens* also differs from *E. dilatatus* in its usually single-flowered inflorescence, its ovate leaf, and its prominently coloured labellum.

The identity of typical *Eriochilus dilatatus* has been unclear until now. Lindley (1840) distinguished *E. dilatatus* from his *E. multiflorus*, *E. latifolius*, *E. tenuis* and *E. scaber* on the basis of its leathery linear-lanceolate leaf with a dilated base, and the few-flowered inflorescence with glabrous ovaries. There are two specimens on the holotype sheet (Figure 1) with leaves 2.5 and 3.5 cm long that were partly folded when pressed giving the appearance of being only about 2 mm wide. Their bases also appear somewhat dilated compared with the types of Lindley's other W.A. species. Both specimens have three flowers.

Lindley (1840) diagnosed *Eriochilus latifolius* by its linear-oblong leaf, its multi-flowered scape with pubescent apices, its oblong bracts, ciliate stems and tomentose ovaries, its sub-rotund labellum, its elongated column and dorsal sepal, and the tomentose anther rim. The single specimen on the type sheet has a leaf 3 cm long \times 5 mm wide, and two flowers on the scape. The latter character conflicts with the "multiflowered" description in the protologue, suggesting that other specimens existed when Lindley described *E. latifolius*.

In any event, subsequent authors have concluded that *Eriochilus latifolius* is a variant of *E. dilatatus*. It was recognised formally at varietal rank by Bentham (1873), with the note that var. *latifolius* was "rather larger; leaves lanceolate. Flowers 2 to 4 and rather longer". Bentham believed that var. *dilatatus* had only 1, 2 or rarely 3 flowers. We have found no other references to *latifolius* until Nicholls (1969) and then George (1971) gave it as a synonym of *E. dilatatus*. Clements (1989) regarded *E. latifolius* as a synonym of *E. multiflorus*.

Our field and herbarium studies have confirmed that the differences between *Eriochilus dilatatus* and *E. latifolius* described by Lindley (1840) fall well within the range of variation found in populations of *E. dilatatus*. Hence we do not recognise *E. latifolius* as a species or subspecies.

The status of *Eriochilus multiflorus* has been more contentious. Lindley (1840) distinguished this species by its ovate-acuminate leaf, its multi-flowered scape with pubescent apices, its oblong bracts, ciliate stems and tomentose ovaries, its labellum oval and obtuse, its shortened column and dorsal sepal, the glabrous anther rim, and with flowers much smaller than those of *E. latifolius*. Bentham (1873) accepted Lindley's concept of *E. multiflorus* as a species distinct from *E. dilatatus*.

Rogers (1920), however, having seen much more material, noted the variation within collections of *Eriochilus dilatatus*, and argued that "it is doubtful whether this species (*E. multiflorus*) should be separated from *E. dilatatus* on the characters assigned to it by Lindley and Bentham." Pelloe (1930) disagreed, and recognised *E. multiflorus* as a distinct species. Many other authors did not (e.g. Erickson 1965; Nicholls 1969; Cady and Rotherham 1970; George 1971; Pocock 1972; Clements 1982; Hoffman and Brown 1984).

Jones (1988) and Clements (1989) reinstated *Eriochilus multiflorus* but circumscribed it somewhat differently to Lindley (1840). They agree that *E. multiflorus* has an ovate leaf. Jones (1988) stated that "*E. multiflorus* is closely related to *E. dilatatus* but has a much smaller leaf and smaller flowers." He also described *E. dilatatus* as having a labellum "sparsely and irregularly beset with tufts of stiff hairs", whereas for *E. multiflorus*, the words 'sparsely and irregularly' were not used. The midlobe of the labellum was described as "broad, much-expanded" in both species. Jones (1988) suggested that *E. dilatatus* was widespread and in almost all habitats from the coast to well inland in the wheatbelt, whereas *E. multiflorus* was believed to be endemic to the extreme southwest, where it is "common in coastal scrubs".

Clements (1989), reversed these notions of abundance and geographical distribution, proposing that *Eriochilus multiflorus* "is the common widespread species in Western Australia that has been called *E. dilatatus*." He regarded *E. dilatatus* as in fact being rare and localized, possibly confined to the southwest jarrah forest region. Clements (1989) also stated that *E. dilatatus* differed from *E. multiflorus* in its "linear leaves and in having a narrower labellum on which there are fewer cilia". He did not contrast floral size in the two species, and, in fact, gave *E. latifolius* as a synonym of *E. multiflorus*. However, as Lindley (1840) noted, the types of these two taxa differ significantly in floral size.

We have examined the types of *Eriochilus multiflorus* and *E. dilatatus*, and completed extensive field and herbarium studies of variation in these orchids. We find flower size, labellum shape and the abundance of hairs on the labellum all to be variable characters that are uncorrelated and of limited taxonomic significance. The only characters that appear to distinguish geographically-based taxa are leaf size and shape, and the number of flowers in the inflorescence. Six races are recognisable. Thus, mainly coastal populations west of Israelite Bay consistently have navicular leaves and usually 3–5 flowers, matching typical *E. dilatatus*. Most *Banksia* woodland and jarrah forest populations and those on wheatbelt granite outcrops have small narrowly ovate to ovate leaves, often not fully expanded on flowering scapes, and have 3–20 flowers seen mainly after fire, matching typical *E. multiflorus*.



Figure 1. Holotype of *Eriochilus dilatatus*. Mangles s.n.

Wheatbelt shrubland and wandoo woodland plants typically have small ovate leaves with undulate margins and 1–3 flowers. They do not require fire to flower, and represent the subspecies described below as *undulatus*. Eastern plants on limestone near Toolinna Cove on the Great Australian Bight which also do not require fire to flower have broadly ovate leaves with rarely undulate margins, fully expanded at anthesis, with moderately fleshy stems and with 2–7 flowers per scape are described as subspecies *orientalis*. Karri and high rainfall jarrah forest plants have large ovate leaves and up to 20 flowers—the new subspecies *magnus* described below. Lastly, populations in the Kalbarri–Dongarra region removed from the coast have small leaves and dark-coloured fleshy scapes. They flower later and do not require fire to flower. They match Bentham's (1873) *E. dilatatus* var. *brevifolius*, which we recognize below as a subspecies.

Our research indicates that these races intergrade extensively where their ranges overlap. Because of this intergradation, we consider subspecific rank to be appropriate, and thus treat below *Eriochilus multiflorus* and the other five races as subspecies of *E. dilatatus*. The six subspecies are distinguished in the following key.

Key to subspecies of *Eriochilus dilatatus*

1. Leaf on flowering plants usually >30 mm long 2
2. Leaf on flowering plants navicular to narrowly navicular with an attenuate acute apex; coastal calcareous soils *E. dilatatus* subsp. *dilatatus*
- 2: Leaf on flowering plants narrowly ovate–ovate with a shortly acute apex; ubiquitous in high-rainfall habitats except calcareous coastal soils *E. dilatatus* subsp. *magnus*
- 1: Leaf on flowering plants usually <30 mm long 3
3. Leaf on flowering plants navicular to narrowly navicular with an attenuate acute apex; confined to coastal calcareous soils *E. dilatatus* subsp. *dilatatus*
- 3: Leaf on flowering plants usually narrowly ovate–ovate with a shortly acute apex; not on coastal calcareous soils (except for subsp. *orientalis*) 4
4. Scape of 3–20+ flowers; high rainfall forests and/or wheatbelt granite outcrops 5
- 4: Scape of 1–3 (–7) flowers; semiarid country, absent from high rainfall forest 6
5. Leaf on flowering plants usually fully expanded; lateral sepals usually 15–18 mm long; ubiquitous in high-rainfall habitats *E. dilatatus* subsp. *magnus*
- 5: Leaf on flowering plants often usually fully expanded; lateral sepals usually 10–15 mm long; high rainfall forests and wheatbelt granite outcrops *E. dilatatus* subsp. *multiflorus*
6. Leaf on flowering plants often not fully expanded, with flat margins; 3–20+ flowers per scape; wheatbelt granite outcrops *E. dilatatus* subsp. *multiflorus*
- 6: Leaf on flowering plants usually fully expanded, with or without undulate margins; 1–3 (–7) flowers per scape; shallow soils on limestone or sandstone, or deeper wheatbelt soils 7
7. Leaf on flowering plants with margins rarely undulate; scapes fleshy, 15–25 cm tall; flowers 2–7 per scape; confined to limestone near Toolina Cove *E. dilatatus* subsp. *orientalis*
- 7: Leaf on flowering plants with margins undulate; scapes wiry or fleshy, 5–20 cm tall; flowers 1–3 per scape; on sandstone or in deep wheatbelt soils 8
8. Leaf pale maroon with greenish streaks below; scapes green, wiry; flowering April–mid-May; widespread in wheatbelt and adjacent semi-arid woodlands on deep soils *E. dilatatus* subsp. *undulatus*
- 8: Leaf uniformly pale maroon below; scapes pale maroon, thick; flowering mid-May–June; restricted to red loams in well-watered areas and shallow soil in sandstone areas from Dongara north to the Murchison River area *E. dilatatus* subsp. *brevifolius*

Eriochilus dilatatus* Lindley subsp. *dilatatus

Eriochilus latifolius Lindley in Edward's Bot. Reg. 1–23: Swan River Appendix liii (1840); *Eriochilus dilatatus* Lindley var. *latifolius* (Lindley) Benth., Fl. Austral. 6: 373 (1873). *Type*: Swan River, 1839, *J. Drummond s.n. (holo: K-L!; iso W!)*.

Illustrations. D. Jones, *Native Orchids of Australia*, p. 159, extreme right drawing, as *E. dilatatus* (1988); M. Hodgson & R. Paine, *Field Guide to Australian Orchids*, 151 – possibly this subspecies (1989); N. Hoffman & A. Brown, *Orchids of South-West Australia*, 2nd ed., 179 (1992) and rev. 2nd edn with suppl., 179 (1998); D. Jones & B. Jones, *A Field Guide to the Native Orchids of Southern Australia*, p. 138 (2000).

Leaf on flowering plants concolorous, green, usually fully expanded at anthesis, navicular to narrowly navicular with an attenuate acute apex and flat margins, 5–70 mm long, 2–10 mm wide; *scape* green, wiry, 10–35 cm tall; *inflorescence* with 1–7 widely spaced flowers; *lateral sepals* 15–20 mm long; *labellum* hairs pale cream.

Specimens examined. WESTERN AUSTRALIA: *s.loc., s.dat., Anonymous s.n. (a)* (PERTH 00243760); Stokes National Park, 33° 49' 00" S, 121° 10' 00" E, 05 May 1989, *K. Bradbury DL4* (PERTH 1828681); Stokes National Park, 33° 49' 00" S, 121° 10' 00" E, 04 May 1989, *K. Bradbury S13* (PERTH 1828746); Peelhurst Rd, c. 830 metres W of Mandurah–Fremantle road, opposite House Number 120, 32° 29' 30" S, 115° 45' 00" E, 01 June 1988, *A. Brown 817* (PERTH 01026127); Ledge Point, due E of Albany, overlooking King George Sound, 35° 01' 00" S, 118° 00' 00" E, 02 May 1989, *A. Brown 926* (PERTH 01029223); Ludlow Tuart Forest, c. 14.6 km NE of Busselton, 33° 37' 00" S, 115° 28' 00" E, 09 May 1989, *A. Brown 930* (PERTH 01026100); Moses Rock, between cleared farmland and ocean, 33° 46' 00" S, 114° 59' 00" E, 09 May 1989, *A. Brown 931* (PERTH 01026097); Near Augusta, Mar. 1926, *W.E. Campions s.n.* (PERTH 00242357); Rest Point–Walpole Inlet, 21 Apr. 1973, *R.A. Congdon s.n.* (PERTH 00914363); Ocean Reef Beach, 30 May 1978, *R.J. Cranfield 662A* (PERTH 00241784); N of Mullaloo on boundary of Ocean Reef, 30 May 1978, *R.J. Cranfield 662B* (PERTH 00241865); 3 km SE of Natural Bridge turnoff on Frenchmans Bay Rd, Albany, 35° 06' 00" S, 117° 55' 00" E, 18 Apr. 1980, *R.J. Cranfield 1421* (PERTH 00269190); W side of Gairdner River Estuary, Fitzgerald River National Park, 20 May 1978, *S. Downes s.n.* (PERTH 00269212); Naraling, NE of Geraldton, 13 May 1961, *A.S. George 2358* (PERTH 00244252); c. 25 miles E of Dindiloa, NE of Geraldton, 14 May 1961, *A.S. George 2382* (PERTH 00243787); W of Two Wells, Dirk Hartog Island, 26° 01' 00" S, 113° 11' 00" E, 08 Sep. 1972, *A.S. George 11613* (PERTH 00242268); c. 7 km W of Israelite Bay, 33° 38' 00" S, 123° 48' 00" E, 14 Aug. 1980, *A.S. George 16013* (PERTH 00241342); S Bunbury, *s.dat., B.T. Goadby s.n.* (PERTH 00241814); Albany, *n.dat., B.T. Goadby s.n. (a,c)* (PERTH 00242748); South Bunbury, May 1929, *B.T. Goadby s.n. (c,d)* (PERTH 00242241); 8 km W of Lake Logue, 29° 52' 00" S, 115° 06' 00" E, 01 June 1978, *E.A. Griffin 1019* (PERTH 00244198); Sandy Hook Island, Archipelago of the Recherche, 34° 02' 00" S, 122° 00' 00" E, 01 May 1982, *S.D. Hopper 2244* (PERTH 00241377); Ocean Reef, NW of (PERTH, c. 500 metres NW of intersection of Ocean Reef Rd and Dampier Avenue, 12 May 1985, *S.D. Hopper 4394* (PERTH 00793779); Woolbale Hills, W of Walpole, 34° 59' 00" S, 116° 36' 00" E, 17 Apr. 1990, *W. Jackson BJ 170* (PERTH 01699989); Isthmus Hill, Flinders Peninsula, Torndirrup National Park, 11 May 1988, *G.J. Keighery 10024* (PERTH 01124293); William Bay National Park, 35° 01' 00" S, 117° 15' 00" E, 01 1984, *C.V. Malcolm 66* (PERTH 00899585); Garden Island, 10 May 1951, *W. McArthur s.n.* (PERTH 00913308); Cape Naturaliste, A.P.B. (Agricultural Protection Board) Rabbit Study Area, Grid square 0411, 22 May 1980, *M.H. Robinson s.n.* (PERTH 00269611); Torpedo Rocks, Yallingup, 31 July 1950, *R.D. Royce 3221* (PERTH 00243698); Cape Le Grand National Park, 21 Oct. 1969, *R.D. Royce 8739* (PERTH 00244236); Coomalbidgup Swamp, Map 422/80 24633, 23 Apr. 1978, *D.R. Voigt 31* (PERTH 00243256); West Ridge (more or less below Flinders Peak) Middle Island, Recherche Archipelago, 34° 06' 00" S, 123° 10' 00" E,

14 Nov. 1974, *A.S. Weston* 9896 (PERTH 00269638); Middle Island, Recherche Archipelago, 34° 06' 00" S, 123° 11' 00" E, 17 Nov. 1973, *A.S. Weston & M.E. Trudgen* ASW 8761 (PERTH 00242837); Moun. Hopkins, Walpole–Nornalup National Park, 18 May 1978, *T.G. Wilson s.n.* (PERTH 00243221).

Distribution and habitat. Confined to coastal and insular calcareous soils often over limestone from Dirk Hartog Island in Shark Bay to Israelite Bay. A wide range of vegetation types provide habitat, including coastal heaths, scrubs and peppermint woodlands, and tuart forest. (Figure 2A)

Flowering period. March to May, more profuse following summer fire.

Notes. The navicular leaves and calcareous near-coastal habitat west of Israelite Bay distinguish the typical subspecies from the others. Flowering is often fire-stimulated. Intergrades with *Eriochilus dilatatus* subsp. *multiflorus* where jarrah and *Banksia* woodlands or coastal granite vegetation abuts calcareous coastal heath, peppermint woodlands and tuart forest. Also intergrades with *E. dilatatus* subsp. *undulatus* along the south coast (e.g. *S.D. Hopper* 7155).

Eriochilus dilatatus* subsp. *brevifolius* (Benth.) Hopper & A.P. Br., *comb. nov.

Eriochilus dilatatus Lindley var. *brevifolius* Benth., Fl. Austral. 6: 373 (1873), *pro parte*. *Typus:* Murchison River, *Oldfield s.n.* (a) (*lecto:* K-L!, here chosen).

Leaf on flowering plants discolorous, green above and uniformly pale maroon below, often not fully expanded at anthesis, usually narrowly ovate–ovate with a shortly acute apex, margins undulate, 8–14 mm long, 5–8 mm wide; *scape* pale maroon, thick, usually 6–15 cm tall; *inflorescence* with 1–3 widely spaced flowers; *lateral sepals* 7–10 mm long; *labellum* hairs pale cream with maroon suffusions.

Specimens examined. WESTERN AUSTRALIA: Warribanno Chimney Rd, 1.2 km N of Ajana–Kalbarri Rd, 27° 56' 21" S, 114° 36' 36" E, 13 June 1999, *A.P. Brown* 2536 (PERTH); Binnu West Rd, 9.2 km W of NW Coastal Hwy, 28° 02' 46" S, 114° 34' 52" E, 13 June 1999, *A.P. Brown* 2537 (PERTH); NW Coastal Hwy, 37.6 km N of Galena Bridge, 28° 01' 05" S, 114° 18' 17" E, 13 June 1999, *A.P. Brown* 2538 (PERTH); NSW: Murchison River Gorge, c. 15 miles NE of Ajana, 13 May 1961, *A.S. George* 2379 (PERTH 00243701); Red Bluff, 5 km S of Kalbarri, 27° 45' 00" S, 114° 09' 00" E, 06 May 1968, *P.G. Wilson* 6519 (PERTH 00242330).

Distribution and habitat. Known from red earths with *Allocasuarina*–*Acacia* scrub with scattered eucalypts, from shrublands on red rocky bluffs, and from well-watered depressions in kwongan and woodlands from Dongara northwards to the Murchison River region. (Figure 2B)

Flowering period. mid-May to June, not dependent on summer fire.

Notes. This subspecies is distinctive in its discolorous leaves with undulate margins, its thickened scapes, and its late flowering season. *Eriochilus dilatatus* subsp. *dilatatus*, for example, grows very close to *E. dilatatus* subsp. *brevifolius* in coastal habitats at Kalbarri, but is finished flowering by mid-May when subsp. *brevifolius* is just commencing to flower. *E. dilatatus* subsp. *brevifolius* is the only taxon in the genus to grow in red clay-loam in Western Australia.

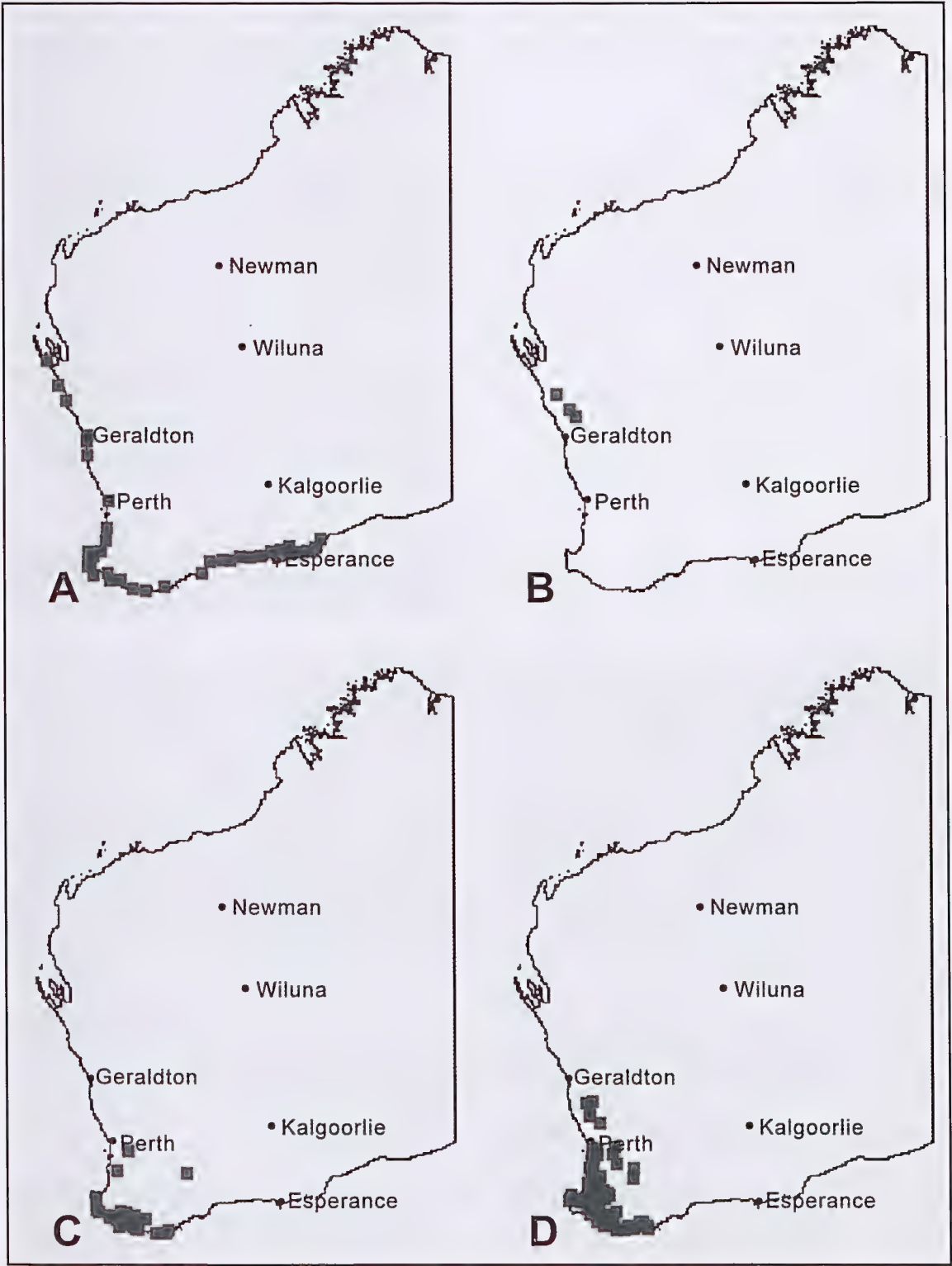


Figure 2. Distribution maps. A – *Eriochilus dilatatus* subsp. *dilatatus*; B – *Eriochilus dilatatus* subsp. *brevifolius*; C – *Eriochilus dilatatus* subsp. *magnus*; D – *Eriochilus dilatatus* subsp. *multiflorus*.

Eriochilus dilatatus subsp. *brevifolius* is most similar to *E. dilatatus* subsp. *undulatus*, from which it differs in its discoloured leaf, green above, pale maroon with greenish streaks below, its pale maroon, fleshy scapes, its later flowering in mainly mid-May–June, and in being restricted to well-watered depressions and rocky areas from Dongara north to the Murchison River area.

Bentham (1873) cited two collections under his *Eriochilus dilatatus* var. *brevifolius* – Swan River, *Drummond*, and the lectotype, Murchison River, *Oldfield*. The *Drummond* specimen appears to be *E. dilatatus* subsp. *multiflorus*.

***Eriochilus dilatatus* subsp. *magnus* Hopper & A.P. Br., subsp. nov.**

A subspeciebus aliis *E. dilatatus* R.Br. folio ovato magniore 2–6 cm longis et 12–22 mm latis, marginibus planis, et scapoque multifloribus differt.

Typus: Warren National Park, c. 10 km N of the Pemberton–Northcliffe Rd, 34°28' S 115°57' E, 10 May 1989, A. Brown 936 (*holo*: PERTH 1029207!)

Illustrations. R. Erickson, *Orchids of the West*, 2nd ed., plate 19, left illustration, as *E. dilatatus* (1965); W. Nicholls, *Orchids of Australia*, plate 198 b, as *E. dilatatus* 'a broad-leaved form' (1969); N. Hoffman & A. Brown, *Orchids of South-West Australia*, 2nd ed., p. 181 (1992) and rev. 2nd edn with suppl., 181 (1998).

Leaf on flowering plants concolorous, green, narrowly ovate to ovate with a shortly acute apex and flat margins, usually fully expanded at anthesis, 15–75 mm long, 6–30 mm wide; *scape* green, wiry, usually 15–50 cm tall; *inflorescence* with many (usually 4–10, rarely to 20+) widely spaced flowers; *lateral sepals* usually 15–18 mm long; *labellum* hairs pale cream to maroon.

Specimens examined. WESTERN AUSTRALIA: Windy Harbour Rd, c. 900 metres N of Mount Chudalup, 34°46'00" S, 116°04'00" E, 10 May 1989, A. Brown 938 (PERTH 01029193); Forest Grove, 09, *E. Coleman* s.n. (PERTH 00242772); Gordon State Forest, c. 2 km NW of One Tree Bridge, Donnelly River, 500 metres NE of intersection of Adam Rd and Lewin Rd, 34°13'00" S, 115°57'00" E, 17 Apr. 1988, S.D. Hopper 6349 (CBG, PERTH 01191446); Sabina River, Sabina Rd, Whicher Range, 33°45'00" S, 115°26'00" E, 17 May 1991, G.J. Keighery 12371 (PERTH 01668617); Big Brook, Pemberton, *n.dat.*, M. Koch 2580 (PERTH 00242314).

Distribution and habitat. Confined to high rainfall forests of karri, jarrah and marri from the Darling Scarp near Perth south to Augusta and east to the Porongorups. Favours rich loams. (Figure 2C)

Flowering period. April to May, more profuse after summer fire.

Etymology. Named from the Latin *magnus* (large), alluding to the large leaf and tall scapes of the subspecies.

Notes. *Eriochilus dilatatus* subsp. *magnus* is the tallest member of the genus, with scapes to 50 cm tall. It is related to *E. d.* subsp. *multiflorus*, differing in its larger leaf on flowering plants and the more widely spaced flowers on the inflorescence. It flowers most prolifically after fire. *E. dilatatus* subsp. *magnus* intergrades with *E. d.* subsp. *dilatatus* on coastal granite outcrops on the Leeuwin–Naturaliste Ridge (e.g. A. Brown 931, R.D. Royce 3321).

Eriochilus dilatatus* subsp. *multiflorus (Lindley) Hopper & A.P. Br., *comb. nov.*

Eriochilus multiflorus Lindley, Sketch Veg. Swan Riv. Col. 53 (1840). Type: Swan River, *Drummonds.n.* (holo: K-L! (Figure 3); iso: K!).

Illustrations. W. Nicholls, *Orchids of Australia*, plate 198a, as *E. dilatatus* (1969); Cady & Rotherham, *Australian Native Orchids in Colour* 55, t. 45 (1970); N. Hoffman & A. Brown, *Orchids of South-West Australia*, 1st ed., p. 352, as *E. dilatatus* (1984); D. Jones, *Native Orchids of Australia*, p. 159, extreme left illustration, as *E. multiflorus* (1988); E. Bennett, *The Bushland Plants of Kings Park Western Australia*, (Fig. 232, as *E. dilatatus* (1988); N. Hoffman & A. Brown, *Orchids of South-West Australia*, 2nd ed., p. 180 (1992) and rev. 2nd edn with suppl., 180 (1998); J. Riley & D. Banks, *Orchids of Australia*, p. 155, as *E. multiflorus* (2002).

Leaf on flowering plants usually concolorous, green, occasionally with dull maroon markings beneath, narrowly ovate to ovate with a shortly acute apex and flat margins, often not fully expanded at anthesis, 8–30 mm long, 3–10 mm wide; *scape* green, wiry, 15–40 cm tall; *inflorescence* usually with up to 5 widely-spaced flowers or rarely to 20+ closely packed flowers; *lateral sepals* usually 10–15 mm long; *labellum* hairs pale cream to maroon.

Specimens examined. WESTERN AUSTRALIA: Kalamunda, May 1915, *W.B. Alexander s.n.* (PERTH 00241830); Wambyn Nature Reserve, 14 km W of York, 16 May 1985, *G.J. Keighery & J.J. Alford* 307 (PERTH 00578509); Claremont, 08 June 1902, *C. Andrews s.n.* (PERTH 00241776); Guildford, Apr. 1901, *C. Andrews s.n.* (PERTH 00241806); Guildford, Apr. 1901, *C. Andrews s.n.* (PERTH 00242306); Guildford, Apr. 1901, *C. Andrews s.n. (a)* (PERTH 00244643); Claremont, Apr. 1901, *C. Andrews s.n. (b)* (PERTH 00244651); N.I., *n.dat.*, *Anonymous s.n.* (PERTH 00243779); N.I., 07 Apr. 1932, *Anonymous s.n.* (PERTH 00269239); N.I., *n.dat.*, *Anonymous s.n. (b)* (PERTH 00909580); W of Tunnel Rd, study plot 64, Worsley Mine Site, 10 km S of Boddington, 22 Apr. 1982, *K.J. Atkins* KA162 (PERTH 00240893); Bunbury, 7 May 1929, *I. Banks s.n.* (PERTH 00242284); South Bunbury, *n.dat.*, *I. Banks s.n.* (PERTH 00242276); Junction of Hines and Scarp Rds, c. 4 km ENE of North Dandalup, 32° 30' 00" S, 116° 01' 30" E, 01 June 1988, *A. Brown* 818 (PERTH 01029177); Bakers Junction Nature Reserve, on the track running parallel to the E boundary, c. 50 metres W of the boundary, 34° 56' 00" S, 117° 55' 00" E, 02 May 1989, *A. Brown* 925 (PERTH 01029231); Gravel reserve at the junction of South-West Hwy and Marbellup Rd due W of Marbellup Nature Reserve, 34° 59' 00" S, 117° 43' 00" E, 02 May 1989, *A. Brown* 928 (PERTH 01029258); Bunbury Bypass, c. 1 km E of Bussell Hwy on S side, 33° 20' 00" S, 115° 39' 00" E, 09 May 1989, *A. Brown* 929 (PERTH 01029215); 250 meters S of Cowaramup Bay road, c. 700 meters W of Caves Rd, 33° 52' 00" S, 115° 01' 00" E, 09 May 1989, *A. Brown* 934 (PERTH 01026119); Brockman Hwy, at Alexandra Bridge, 34° 10' 00" S, 115° 12' 00" E, 10 May 1989, *A. Brown* 935 (PERTH 01029185); Carey Brook, Donnelly River, 20 Mar. 1965, *W.H. Butler s.n.* (PERTH 00269182); Mills Rd, Gosnells, 12 May 1980, *R.J. Cranfield* 1196 (PERTH 00241296); 1 km SW of Horne Rd, 4.5 km W of main road to Manjimup, 34° 27' 00" S, 116° 12' 00" E, 27 May 1989, *R.J. Cranfield* RJC7653 (PERTH 01667521); N of Cranbrook, 21 Apr. 1931, *R. Erickson s.n.* (PERTH 00923923); Junction of Nannup Rd and Sabina Rd, Busselton, Apr. 1978, *M.E. Foote s.n.* (PERTH 00269220); Bartram Rd, Jandakot, 02 May 1960, *A.S. George* 829 (PERTH 00241849); Bartram Rd, Jandakot, 30 Apr. 1961, *A.S. George s.n.* (PERTH 00241393); 2 miles E of Nornalup, 23 Apr. 1962, *A.S. George s.n.* (PERTH 00242810); 2 miles SW of Donnybrook, 20 Apr. 1966, *A.S. George* 7714 (PERTH 00243213); Warton Rd, 31 July 1977, *A.S. George s.n.* (PERTH 00241768); Glen Forrest, May 1936, *B.T. Goadbys n.* (PERTH 00242292); King George Sound, Apr. 1899, *B.T. Goadbys n. (e)* (PERTH 00870463); Marbellup Townsite Reserve, 15 km W of Albany, 22 Apr. 1980, *J.W. Green* 4951 (PERTH 00240915); Capel, May 1920, *D.A. Herberts n.* (PERTH 00244201); Junction of McAlinden–Power Station Roads, c. 7 km SE of Collie, 32° 24' 00" S, 116° 12' 00" E, 26 Mar. 1986, *S.D. Hopper* 4778 (PERTH 00910120); 0.5 km N along

Old School Rd, Elleker, c. 15 km W of Albany, 35°01'00" S, 117°44'00" E, 04 May 1989, *S.D. Hopper* 7161 (AD, CBG, PERTH 01191470); 1.2 km W of C.A.L.M. Walpole, on the South Western Hwy, 34°59'00" S, 116°44'00" E, 4 May 1989, *S.D. Hopper* 7168 (CBG, PERTH 01191861); Shannon Rock, E side of South Western Hwy, 8.4 km NW of Shannon River Bridge, c. 40 km SE of Manjimup, 34°32'00" S, 116°23'00" E, 4 May 1989, *S.D. Hopper* 7170 (CBG, PERTH 01191454); Nillup, 1934, *L. Horburys.n.* (PERTH 00242780); Nillup, 1934, *L. Horburys.n.* (PERTH 00242721); Nillup, 1934, *L. Horburys.n. (c)* (PERTH 00870471); North Boyanup Rd opposite Bunbury Airport, c. 10 miles NE Bunbury, 21 May 1970, *G.J. Keighery* 708 (PERTH 00241857); 22 km SSE of Nannup on Pemberton Rd, 23 Apr. 1973, *G.J. Keighery* 4322 (PERTH 00241288); Kojaneerup Spring, E Stirling Ranges, 16 May 1982, *G.J. Keighery* 5693 (PERTH 00240907); Margaret River District, 28 Apr. 1919, *A.H. Manns.n.* (PERTH 00244171); Canningvale, 1 km S along Ranford Rd from Nicholson Rd, 32°06'00" S, 115°52'00" E, 14 May 1986, *R. Peakall* 103 (PERTH 00847291); Kendenup, 221 mile peg (Perth–Albany Rd (3 km N of Mount Barker), 7 Apr. 1932, *W. Rowe.s.n.* (PERTH 00242349); Cut Hill, W of York, 7 May 1905, *O.H. Sargents.n.* (PERTH 00242799); Cut Hill, W of York, 19 May 1907, *O.H. Sargent* 451 (PERTH 00242764); Cut Hill, W of York, 19 May 1907, (?) *O.H. Sargents.n.* (PERTH 00244244); Reserve C8120, Coulston Rd, Boya, 26 May 1985, *P. Sawyer* 013 (PERTH 00404160); Bickley, 06 May 1948, *N.H. Speck.s.n.* (PERTH 00927104); Bickley, May 1949, *N.H. Speck.s.n.* (PERTH 00927082); Bickley, May, *N.H. Speck.s.n.* (PERTH 00927090); 16 km N of Albany on road to Borden, 09 May 1969, *P.G. Wilson* 8301 (PERTH 00244163).

Distribution and habitat. Found in the jarrah (*Eucalyptus marginata*) forest from north of Perth to Albany, and in banksia woodlands on the Swan Coastal Plain, extending southwards to the Leeuwin–Naturaliste Ridge. Grows in sand or laterite. Also extends eastwards on wheatbelt granite outcrops. (Figure 2D)

Flowering period. March to May, more profuse following summer fire.

Notes. A common subspecies often found in large numbers after fire. Intergrades with other subspecies where their habitats overlap. It is recognized by its usually larger number of flowers (only subsp. *magnus* is similarly as multi-flowered) and its leaf often not fully expanded on flowering scapes.

We concur with Lindley (1840), Jones (1988) and Clements (1989) that *Eriochilus dilatatus* subsp. *multiflorus* has a smaller more ovate leaf than the typical subspecies. However, our studies have not confirmed consistent differences described by these authors in flower size, labellum shape nor in the abundance of labellum hairs. Consequently, we propose subspecific status rather than recognizing *multiflorus* as a species.

***Eriochilus dilatatus* subsp. *orientalis* Hopper & A.P. Br., subsp. nov.**

A subspeciebus aliis *E. dilatato* R.Br. folio ovato lanceolato 15–30 mm longis et 7–10 mm latis, marginibus planis, et scapoque multifloribus differt.

Typus: Toolinna Cove, 32°45'00" S, 124°59'00" E, 26 April 1988, *G.J. Keighery & J.J. Alford* 1945 (*holo:* PERTH 01751492; *iso:* CBG!).

Leaf on flowering plants concolorous, green, narrowly ovate with a shortly acute apex and flat margins (rarely undulate), fully expanded at anthesis, 15–30 mm long, 7–15 mm wide; *scape* green, fleshy, 15–26 cm tall; *inflorescence* with 1–7 (usually 3–5) widely spaced flowers; *lateral sepals* 8–12 mm long; *labellum* hairs usually maroon.

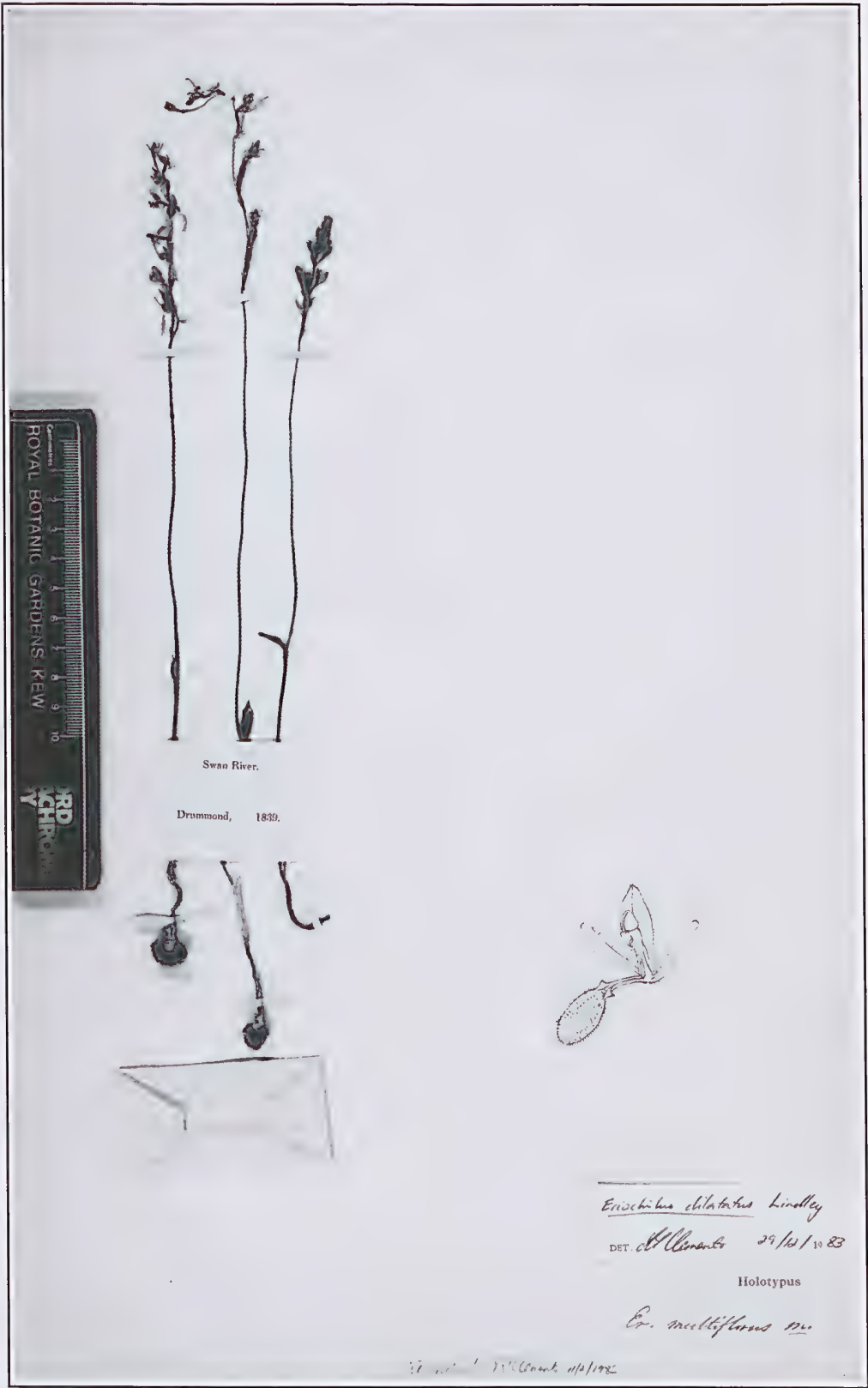


Figure 3. Holotype of *Eriochilus multiflorus*. Swan River, Drummond 1839.

Specimens examined. WESTERN AUSTRALIA: Toolinna Cove, 6 May 2004, *A.P. Brown* 7162 (PERTH 07319169); 32.5 km S of Caiguna via Baxters Memorial Track; Caiguna is c. 380 km E of Norseman, 24 Aug. 1983, *M.J. Fitzgerald* B93 (PERTH 00241385).

Distribution and habitat. Confined to coastal limestones in the Toolina region on the Great Australian Bight where it grows in low heath of *Melaleuca pulchella*, *Templetonia retusa*, *Westringia dampieri*, *Bossiaea obcordata*, *Goodenia varia* and *Acacia* sp., mainly in shallow soil pockets, extending inland into low mallee of *Eucalyptus angulosa* and *E. surgens*. Other orchids that occur in the same area include *Pterostylis sanguinea*, *Caladenia microchila*, *Microtis media* and *Genoplesium nigricans*. (Figure 4A)

Flowering period. April to May, not dependent on summer fire.

Etymology. Named from *orientalis* (east), alluding to the geographical position of the subspecies relative to all others.

Notes. *Eriochilus dilatatus* subsp. *orientalis* is the most easterly and disjunct subspecies, distinguished by its leaf on flowering plants fully expanded, narrowly ovate, with margins rarely undulate, its scapes fleshy, 15–25 cm tall and its flowers 2–7 per scape. It is related to *E. dilatatus* subsp. *multiflorus*, differing in its fleshy scapes and leaves, the latter fully expanded at anthesis, flowering regardless of fire, and its fewer-flowered inflorescence. *E. dilatatus* subsp. *orientalis* has only been collected over the past two decades, due to the remoteness of its habitat, which contains other recently described taxa such as *Eucalyptus surgens* (Brooker and Hopper 1993).

***Eriochilus dilatatus* subsp. *undulatus* Hopper & A.P. Br., subsp. nov.**

A subspeciebus aliis *E. dilatato* R.Br. folio ovato 1.5–3.5 cm longis et 5–11 mm latis, marginibus undulatis, et scapoque paucifloribus differt.

Typus: E side of Fowler's Gully in the Wongan Hills, 2 km S of Wongan Hills–Piawaning Rd, 30°50'S 116°38'E, 14 May 1980, *K.F. Kenneally* 7191 (*holo:* PERTH 1220470!; *iso:* PERTH - spirit collection No. 3655/A!).

Illustrations. R. Erickson, *Orchids of the West*, 2nd ed., plate 19, right illustration, as *E. dilatatus* (1965); N. Hoffman & A. Brown, *Orchids of South-West Australia*, 2nd ed., p. 182 (1992) and rev. 2nd edn with suppl., 182 (1998).

Leaf on flowering plants discolourous, green above, pale maroon with greenish streaks below, usually fully expanded at anthesis, usually narrowly ovate with a shortly acute apex, margins undulate, 5–20 mm long, 2–7 mm wide; *scape* green, wiry, 10–20 cm tall; *inflorescence* with 1–3 (rarely more) widely spaced flowers; *lateral sepals* 8–15 mm long; *labellum* hairs pale cream with maroon suffusions.

Specimens examined. WESTERN AUSTRALIA: Key Farm, Toodyay, May 1936, *Anonymous* s.n. (PERTH 00916951); Hatters Hill, E of Varley; Grid Line: 752/1344, 32°49'00"S, 119°59'00"E, 21 Aug. 1990, *P. Armstrong* s.n. (PERTH 1828665); Collie, May 1929, *I. Banks* s.n. (PERTH 00243752); Stokes National Park, 33°49'00"S, 121°10'00"E, 05 May 1989, *K. Bradbury* DL7 (PERTH 1828673); Stokes National Park, 33°49'00"S, 121°10'00"E, 04 May 1989, *K. Bradbury* S14 (PERTH 1828711); Stokes National Park, 33°49'00"S, 121°10'00"E, 05 May 1989, *K. Bradbury* S15 (PERTH 1828738); 211 mile peg, 3 Springs to Mingenew (c. 10 km N of Arrino on Midlands Rd, between Three Springs and Mingenew), 5 May 1964,

A.R. Fairall 1450 (PERTH00242322); c. 1.5 miles W of Quairading, 22 May 1960, *A.S. George* 833 (PERTH00243310); 10 miles N of Hopetoun, 21 Apr. 1962, *A.S. George s.n.* (PERTH00243280); Aurora, 15 Apr. 1932, *B.T. Goadbys n.* (PERTH00269603); Clackline–Lawnswood, 27 May 1950, *J. Hennellys n.* (PERTH00916552); Willsea farm, (Ray Lock's property), c. 10 km SSW of Wellstead, 34°32'00" S, 116°23'00" E, 03 May 1989, *S.D. Hopper* 7155 (PERTH01191888); Puskins reserve, Leeder Rd, Clackline, 12 June 1986, *G.J. Keighery & J.J. Alford* 514 (PERTH00792209); Conways property, E side of Wongan Hills, 194 km NE of Perth, 19 May 1977, *K.F. Kenneally* 6336 (PERTH01220489); Irwin River, 28 May 1950, *W.M. McArthur s.n.* (PERTH00913316); Wyalkatchem, May 1960, *B. Rosier* 277 (PERTH00243795); Cut Hill, W of York, 19 May 1907, *O.H. Sargents n.* (PERTH00243736); Helena Valley, May 1978, *J. Seabrook* 552 (PERTH00241792); Avon Location 19405, SW of Manmanning, 1973, *B.M. Smith s.n.* (PERTH00243728); 100–200 metres N of Canning Mills Rd, 1.5 km E of junction with Tonkin Hwy, 5 June 1989, *A.N. Start s.n.* (CBG, PERTH01197770); Corner of Scaddan and Savage Rds, E of Esperance, 13 Aug. 1978, *D.R. Voigt* 50pp (PERTH00243248); S slope of East Mount Barren, above road, 14 July 1971, *A.S. Weston* 6299 (PERTH00241318); Darlington, 16 May 1931, *R.F. Williams s.n.* (PERTH00922811).

Distribution and habitat. Occurs throughout the wheatbelt from Northampton to east of Esperance, and inland to Mt Jackson and Queen Victoria Rocks in a variety of habitats (e.g. granite outcrops, mallee woodlands, shrublands), extending into the northern jarrah forest and down the Darling Scarp in wandoo woodlands and on granite outcrops. (Figure 4B)

Flowering period. April to May, not dependent on summer fire.

Etymology. Named from the Latin *undulatus* (undulate), alluding to the undulate margins of the leaf on flowering plants.

Notes. *Eriochilus dilatatus* subsp. *undulatus* occurs further inland than other subspecies, and flowers in the absence of fire. Its undulate leaf margins and usually 1–2-flowered scapes are characteristic except for *E. d.* subsp. *brevifolius*. The latter subspecies, ranging from Dongara to the Murchison River area, differs from typical *E. d.* subsp. *undulatus* in its leaf green above and uniformly pale maroon below, its pale maroon, fleshy scapes, its later flowering in mainly mid-May–June, and in being restricted to well-watered depressions and rocky areas.

The pollination of *Eriochilus dilatatus* subsp. *undulatus* by native bees (*Hylaeus dorotheiae*) near Bolgart was first described by Erickson (1965). Flowers have been observed with droplets of nectar at the base of the column (e.g. SDH, pers. obs. at Wambyn Nature Reserve). It would appear that these orchids thus offer a genuine food reward to pollinators, rather than relying on mimicry and deception as do most southwest orchids (Stoutamire 1974, 1975, 1981, 1983; Brown & Hopper, unpubl.). *E. dilatatus* subsp. *undulatus* is similar to *E. helonomos*, but the latter species differs in its shorter ovate leaf, and its restriction to winter-wet habitats.

***Eriochilus helonomos* Hopper & A.P. Br., sp. nov.**

A *E. dilatato* R.Br. folio parviore minus 17 mm longo, saepe ovato marginibus undulatis, et petalis adpressis ad columnam per anthesin differt.

Typus: 2.8 km W along South-Western Hwy from T-junction with Lower Denmark Rd, c. 10 km E of Denmark, 34°57'S 117°28'E, 4 May 1989, *S.D. Hopper* 7164 (*holo:* PERTH1751484!; *iso:* AD! CBG! K!).

Illustrations. N. Hoffman & A. Brown, *Orchids of South-West Australia*, 2nd ed., p. 185 (1992) and rev. 2nd edn with suppl., 185 (1998).

Leaf cauline, glabrous, ovate–acute, acuminate, 7–17 mm long, underside smooth and sometimes suffused dark purple when fresh, margins often undulate. *Leaf of non-flowering plant* 7–17 mm × 2–10 mm. *Leaf of flowering plant* inserted a quarter to a third the way up scape, same size as on nonflowering plants. *Scape* wiry, suffused with dark purple near the base, green above, 8–15 cm tall. *Floral bract* narrowly ovate, to 3 × 2 mm. *Inflorescence* usually single-flowered, rarely 2–3. *Dorsal sepal* cream with brownish-red marginal markings, 6–11 mm by 2–3 mm. *Lateral sepals* cream, underside sometimes faintly suffused pink with a pale median stripe, 7–15 mm by 2–4 mm. *Petals* clasping the column at full anthesis, cream with brownish-red marginal longitudinal stripes, 6–10 mm by 0.5–1.5 mm. *Labellum* 6–9 mm long by 2–4 mm wide; *lamina* 3–4 mm long × 2–4 mm wide, prominently decurved, flattened-orbicular when viewed from front, greenish cream, with scattered clusters of dark red or opaque hairs; *claw* 2.5–4 mm long. *Column* 5–7 mm by 2–3 mm; stem uniformly pale green, tapering slightly towards base. *Anther* greenish yellow with red markings near the margins. *Stigma* clearly visible through a transversely oval orifice; margins of orifice pinkish cream, becoming dark red; lower margins with central and extreme lateral downward dips. *Ovary* green.

Specimens examined. WESTERN AUSTRALIA: Guildford, May 1915, *W.B. Alexander s.n.* (PERTH 00241822); Brookton Hwy, SE of Perth, at the 69.2 km peg, 32° 15' 00" S, 116° 27' 00" E, 31 May 1988, *A. Brown* 813 (PERTH 01197746); 250 metres S of Cowaramup Bay Rd, c. 700 metres W of Caves Rd, 33° 52' 00" S, 115° 01' 00" E, 09 May 1989, *A. Brown* 933 (PERTH 01197711); Boyup Brook–Donnybrook road, c. 25 km NW of Boyup Brook, 33° 40' 00" S, 116° 16' 00" E, 10 May 1989, *A. Brown* 940 (PERTH 01197738); Lots 65 and 66, Junction of Keane Rd and Anstey Rd, Canning Vale, 32° 05' 00" S, 115° 55' 00" E, 17 May 1989, *A. Brown* 941 (PERTH 01197703); Hammond Rd, Jandakot, 14 May 1960, *A.S. Georges n.* (PERTH 00244279); Applecross, May 1929, *B.T. Goadby s.n. (a,b)* (PERTH 00241873); Parking Bay on the E side of Albany Hwy, c. 80 km NW of Williams Post Office, 32° 27' 00" S, 116° 20' 00" E, 01 May 1989, *S.D. Hopper* 7143 (PERTH 01197754); On Eyre River, near Sandalwood Rd, c. 12 km SE of Wellstead, 34° 33' 00" S, 118° 42' 00" E, 3 May 1989, *S.D. Hopper* 7153 (PERTH 01197762); Canning Dam, down slope from quarry, 32° 09' 00" S, 116° 07' 00" E, 28 June 1989, *A.N. Starts n.* (CBG, PERTH 01197681).

Distribution and habitat. WESTERN AUSTRALIA: Ranges widely from Cataby area to Cape Riche. Favours clay-based winter-wet swamps and seeps on granite outcrops. (Figure 4C)

Flowering period. April to June, not dependent on summer fire.

Etymology. Named from the Greek *helos* (marsh, swamp), alluding to the preferred habitat of the species.

Notes. *Eriochilus helonomos* is allied to *E. dilatatus*, especially subspp. *undulatus* and *brevifolius*, but is readily distinguished by its small strongly acute ovate leaf, its inflorescence usually single-flowered, its petals appressed to the column and partly enclosed by the dorsal sepal, and its preference for winter-wet habitats. Vegetative leaves are often found in clumps, suggesting that the species is colonial.

Eriochilus helonomos has been found growing with or adjacent to populations of both *E. dilatatus* and *E. valens*. No hybrids have been found.

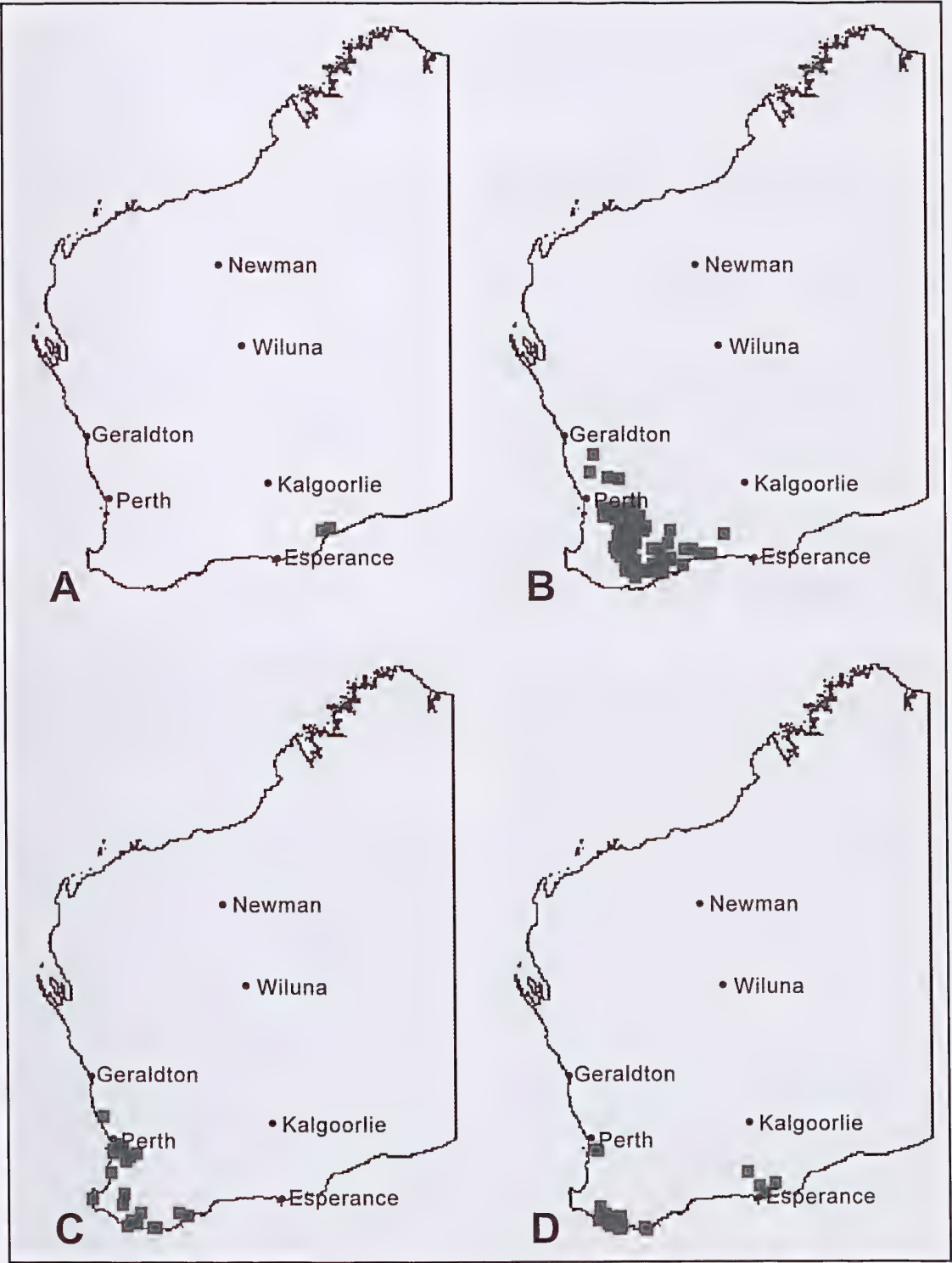


Figure 4. Distribution maps. A – *Eriochilus dilatatus* subsp. *orientalis*; B – *Eriochilus dilatatus* subsp. *undulatus*; C – *Eriochilus helonomos*; D – *Eriochilus pulchellus*.

Eriochilus pulchellus Hopper & A.P. Br., *sp. nov.*

A. E. dilatato R.Br. folio scapoque carnosio, scapo brevi (5–15 cm alto), floribus 3–10 maculatis, prominentibus atropurpureis differt.

Typus: Shannon Rock, E side of South-western Highway, 8.4 km NW of Shannon River Bridge, c. 40 km SE of Manjimup, 34°32'S 116°23'E, 4 May 1989, *S.D. Hopper* 7169 (*holo*: PERTH 1751476!; *iso*: AD! CBG K! MEL!).

Illustrations. N. Hoffman & A. Brown, *Orchids of South-West Australia*, 2nd ed., p. 183 (1992) and rev. 2nd edn with suppl., 183 (1998).

Leaf cauline, fleshy, narrowly ovate and shortly acute, 14–20 mm long, underside prominently ribbed and pale green or dark purple when fresh, margins flat. *Leaf of non-flowering plant* 14–20 mm × 5–7 mm. *Leaf of flowering plant* inserted a quarter to a third the way up scape, same size as on non-flowering plants. *Scape* fleshy, uniformly green or dark purple towards the base and green above, 3–15 cm tall. *Floral bract* narrowly ovate, to 4 × 2 mm. *Inflorescence* usually 3–5-flowered, rarely 1–2, or 6–11. *Dorsal sepal* cream with dark brownish-red marginal markings, 7–10 mm by 3–4 mm. *Lateral sepals* 12–15 mm by 3–4 mm, cream, underside sometimes suffused pink towards the apex. *Petals* spreading away from the column at full anthesis, cream with dark brownish-red marginal longitudinal stripes, 7–9 mm by 1.0–1.5 mm. *Labellum* 8–10 mm long by 2.5–3 mm wide; *lamina* 3–4 mm long by 2.5–3 mm wide, prominently decurved, flattened-orbicular when viewed from front, with a central longitudinal channel devoid of coloured hairs, greenish cream with dense to scattered clusters of dark red hairs; *claw* 3–5 mm long. *Column* 5–8 mm by 2.5–3.5 mm; stem uniformly pale green, tapering slightly towards base, inconspicuously winged. *Anther* greenish yellow with red markings near the margins. *Stigma* clearly visible through a transversely oval orifice; margins of orifice pinkish cream, becoming dark red; lower margins with central and extreme lateral downward dips. *Ovary* green.

Specimens examined. WESTERN AUSTRALIA: Mount Beaumont, 9 Aug. 1980, *A. Brown* s.n. (PERTH 00292877); Windy Harbour Rd, c. 900 metres N of Mount Chudalup, 34°45'00" S, 116°05'00" E, 10 May 1989, *A. Brown* 937 (PERTH 01197673); Mount Ney, 30 Aug. 1984, *M.A. Burgman & C. Layman* MAB 3227 (PERTH 00240885); Condingup, 25 May 1965, *T. Daniell* 12 (PERTH 00913790); NW base of Mount Ney, 33°24'00" S, 122°28'00" E, 7 Aug. 1980, *A.S. George* 15841 (PERTH 00241334); N side of Mount Heywood, 33°20'00" S, 122°32'00" E, 8 Aug. 1980, *A.S. George* 15869 (PERTH 00241326); Sheoak Hill, SE of Mount Ragged, 33°37'00" S, 123°39'00" E, 14 Aug. 1980, *A.S. George* 16030 (PERTH 00241350); SW side of Mount Ragged, 33°28'00" S, 123°28'00" E, 15 Aug. 1980, *A.S. George* 16051 (PERTH 00241369); Junana Rock, 33°23'00" S, 123°24'00" E, 16 Aug. 1980, *A.S. George* 16092 (PERTH 00248096); 13 km SE of Albany on Isthmus Hill in Torndirrup National Park, 35°06'00" S, 117°56'00" E, 23 May 1991, *S.D. Hopper* 7935 (PERTH 1828983); 13 km SE of Albany, 200 metres WNW of lighthouse in Torndirrup National Park, 35°07'00" S, 117°56'00" E, 24 May 1991, *S.D. Hopper* 7936 (PERTH 1828991); Granite outcrop, below and N of Mount Frankland, 34°50'00" S, 116°47'00" E, 25 Apr. 1990, *W. Jackson* BJ171 (PERTH 01700022); SW foothills of Mount Ragged, on breakaway at foot of range, above campsite, 33°27'00" S, 123°29'00" E, 03 Apr. 1989, *M. Lyons* s.n. (PERTH 01190857); Mount Chudalup, near Northcliffe, 34°46'00" S, 116°05'00" E, 13 May 1972, *G.G. Smith* s.n. (PERTH 00928127); Near Mount Merivale Exchange, Map 423/80, 28170, 23 Apr. 1978, *D.R. Voigt* 14pp (PERTH 00243264); Orchid Rocks, Map 391/80, 22 Apr. 1978, *D.R. Voigt* 25 (PERTH 00243272); Wittenoom Hills, W slope, 13 Aug. 1978, *D.R. Voigt* 47pp (PERTH 00244260); Wireless Hill, Esperance, 23 Apr. 1978, *D.R. Voigt* 6 (PERTH 00243744); Western

Edge SW corner of Mount Ragged, 2 Sep. 1978, *D.R. Voigt* 79 (PERTH 00243302); Boyatup Hill, 71 miles E of Esperance, N side of Fisheries Rd, 4 Sep. 1979, *D.R. Voigt* 63pp (PERTH 00243205); Giants Block, Valley of the Giants, E of Walpole, 34° 59' 00" S, 116° 54' 00" E, May 1989, *G. Wardell-Johnson* s.n. (CBG, PERTH 1828401); Shannon Rock, SE of Manjimup, 34° 15' 00" S, 116° 09' 00" E, 18 May 1978, *A. Wilson* s.n. (PERTH 00269204).

Distribution and habitat. Confined to three disjunct areas – high rainfall sites near Perth, and between Northcliffe and Albany, and in the Esperance–Balladonia region. Usually grows in *Campylopus* moss swards on granite outcrops, but one of the Albany populations is in wind-pruned low coastal heath on skeletal limestone. (Figure 4D)

Flowering period. April to May, not dependant on summer fire.

Etymology. Named from the Latin *pulcher* (beautiful), and the diminutive suffix *-ellus*, alluding to the brightly coloured flowers and diminutive stature of the type population of the species.

Notes. *Eriochilus pulchellus* is allied to *E. dilatatus* but is readily distinguished by its fleshier stouter leaves and scapes, its more colourful flowers, and its preference for rock outcrops.

Populations of *Eriochilus pulchellus* at Shannon Rock and Little Mt Chudalup appear to be light sensitive, with all flowers facing northwards towards the sun. The species does not require fire to flower well. It is colonial in habit.

Eriochilus scaber Lindley, Sketch Veg. Swan Riv. Col. 53 (1840). *Type:* Swan River, *Drummonds* s.n. (*holo:* K-L! (Figure 5); *iso:* K!).

Leaf basal, orbicular or narrowly ovate to ovate, shortly acute, 3–20 mm long, margins flat. *Leaf of non-flowering plant* glabrous, discolorous, lamina flat; upper surface dark green with five white longitudinal stripes, evenly hirsute; margins and lower surface dark maroon becoming paler greenish cream towards the centre, 3–12 mm × 2–10 mm. *Leaf of flowering plant* inserted a tenth or less the way up scape, concolorous, yellowish green, glabrous, lamina cupped around scape, larger than on nonflowering plants in subsp. *scaber*, 7–17 mm × 7–15 mm; similar in size to those on nonflowering plants in subsp. *orbifolia*, 8–20 mm × 10–15 mm. *Scape* wiry, uniformly green (sometimes becoming suffused dull maroon near ovary), usually less than 10 cm tall, sparsely hirsute. *Floral bract* broadly ovate, to 6 × 4 mm. *Inflorescence* 1–3-flowered. *Dorsal sepal* conspicuously hairy on outside, glabrous inside, with pale pink markings, 6–8 mm × 2–3 mm. *Lateral sepals* conspicuously hairy on the outside, glabrous inside, broadly lanceolate, pale pink (rarely cream), 8–12 mm × 3–5 mm. *Petals* appressed to column at full anthesis, sparingly hirsute on apical margins only, with dark pink median and marginal longitudinal stripes, 5–8 mm × 1.5–2 mm. *Labellum* 5–8 mm long × 2–3 mm wide; *lamina* 1.5–4 mm long × 2–3 mm wide, prominently decurved, flattened-orbicular when viewed from front, uniformly dark rose pink, with dense clusters of hairs; *claw* 3–5 mm long. *Column* to 5 × 2 mm; stem uniformly pale green, slender (0.5–1 mm wide), tapering slightly towards base, inconspicuously winged, becoming shortly hirsute towards the stigma. *Anther* uniformly dark pink except for white irregularly serrate margins. *Stigma* scarcely visible through a slender horizontal orifice; margins of orifice white, becoming dark pink elsewhere. *Ovary* brownish maroon to dark red, hairs sometimes grouped in longitudinal clusters along ribs.

Distribution and habitat. In scattered populations from the Lesueur National Park near Jurien south to Augusta and eastwards to Cape Arid National Park. Usually occurs in winter-wet swamps. On the Swan Coastal Plain it favours swamps on the Bassendean Dunes, and is rare in clay-based swamps of the Pinjarra Plain and Darling Plateau. In the southern forests and along the south coast, the species occurs on the margins of sandy and peaty swamps, and may also occur in damp situations away from swamps. It occurs in swamps near Esperance, but is confined to damp run-off areas on granite outcrops to the north and east thereof.

Associated vegetation varies throughout wide geographical range of the species, from *Melaleuca* dense heath near Jurien, *Pericalymma*–*Melaleuca* heath with emergent *M. preissiana*–*Banksia littoralis* low woodland near Perth and Busselton, *Homalospermum*–*Beaufortia* heath and jarrah-marri forest near Manjimup, Walpole and Albany, low heath near Esperance, and in *Borya* herbfields on granite outcrops.

Flowering period. July to August between Jurien and Busselton, and also near Esperance; September to early October along the south coast between Augusta and Albany. Dependent on summer fire.

Typification. There are two specimens mounted on the holotype sheet in the Lindley Herbarium at K (Figure 5). The sheet is clearly annotated “*Er. scaber* m.” in Lindley’s hand, and the specimens match the protologue in every detail. There are no problems, therefore, in applying the name.

Notes. *Eriochilus scaber* has been traditionally regarded as close to *E. cucullatus sens. lat.* (e.g. Nicholls 1969), and more recently to *E. tenuis* (e.g. Jones 1988). However, *E. autumnalis* may well be the closest named relative of *E. scaber* because both have basal leaves that are dark green, hairy and prominently veined, and both have hairy scapes and pale pink (occasionally cream) flowers. *E. scaber* differs from *E. tenuis* in its shorter hirsute scapes usually less than 10 cm tall, its leaf on non-flowering plants striped above and red beneath, and its generally earlier flowering from July–October.

The leaves of non-flowering plants are held flat on the ground and are darker green, hirsute and more prominently veined than those on flowering plants. This dimorphism in leaves of non-flowering and flowering plants is the most striking of any southwest orchid.

A race of *E. scaber* confined to coastal heath near Walpole is here described as subsp. *orbifolia*, and distinguished from the type subspecies in the following key.

Key to subspecies of *Eriochilus scaber*

1. Leaf orbicular, held flat on ground; petiole creamy green,
1–3 mm above ground ***E. scaber* subsp. *orbifolia***
- 1: Leaf narrowly ovate to ovate, obliquely ascending; petiole
dark maroon or creamy green, 2–12 mm above ground ***E. scaber* subsp. *scaber***

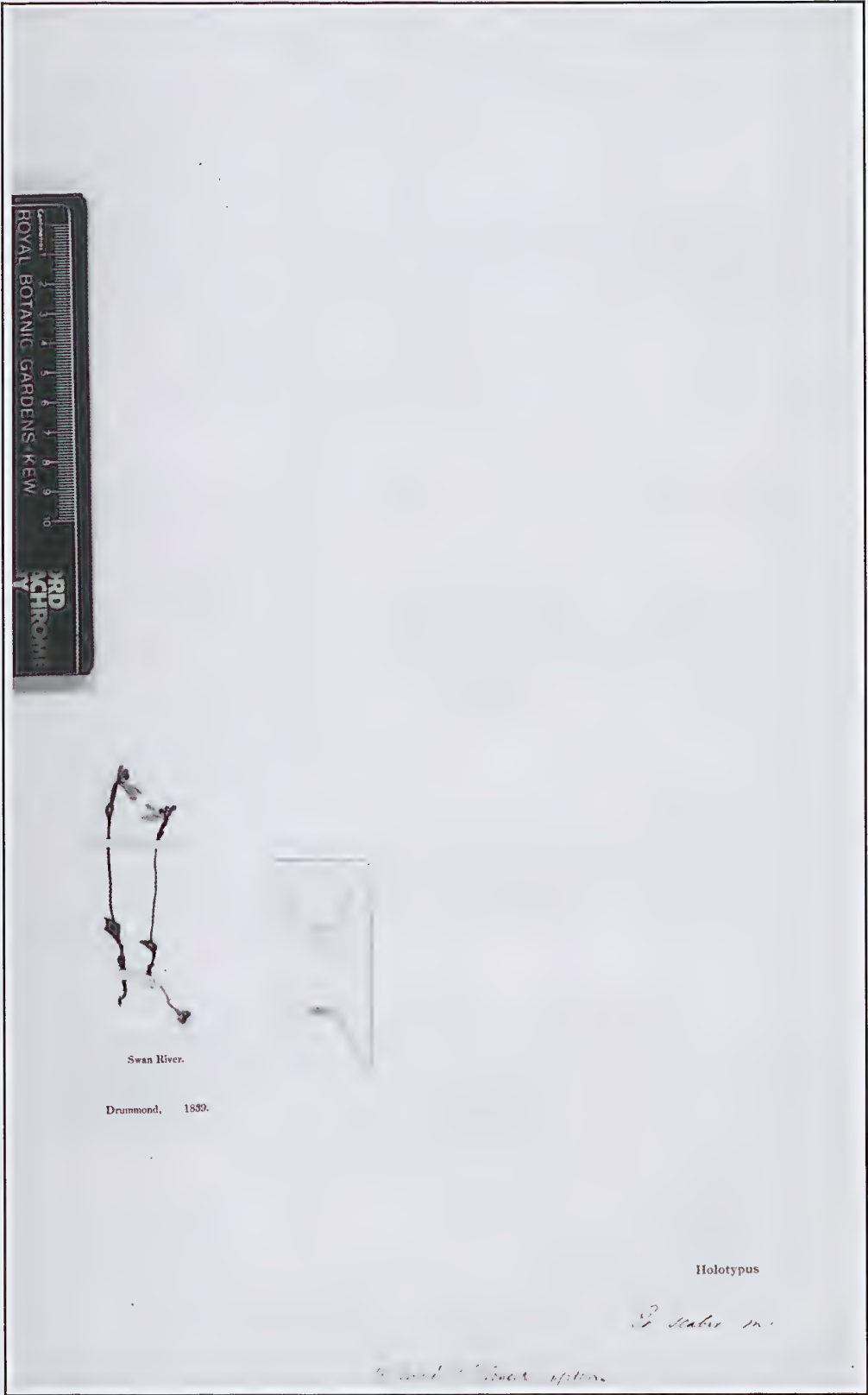


Figure 5. Holotype of *Eriochilus scaber*. Swan River, *Drummond s.n.*

Eriochilus scaber* Lindley subsp. *scaber

E. lindleyi Endl. in Lehm., Pl. Preiss. 2:10 (1846) – *E. scaber* Lindley var. *lindleyi* (Endl.) H.G. Reichb., Beitr. Syst. Pfl. 62 (1871). *Typus*: near Canning River, 22 July 1839, L. Preiss 2206 (*lecto*: W!, *fide* A.S. George, *Nuytsia* 1: 182, 1971; *iso*: G! P! W!, *fide* A.S. George, *Nuytsia* 1: 182, 1971).

Illustrations. R. Fitzgerald, *Australian Orchids*, Vol. 2. Pt2 (1876, reprinted 1977); W. Blackall & B. Grieve, *How to Know Western Australian Wildflowers*, Part 1, p. 91 (1954); W. Nicholls, *Orchids of Australia*, plate 200a–i (1969); R. Erickson, A. George, N. Marchant & M. Morcombe, *Flowers and Plants of Western Australia*, 1st ed., p. 34 plate 67 (1973); N. Hoffman & A. Brown, *Orchids of South-West Australia*, 1st ed., p. 350 (1984); C. Woolcock & D. Woolcock, *Australian Terrestrial Orchids*, plate 2C (1984); D. Jones, *Native Orchids of Australia*, p. 158 bottom photograph, p. 159 top illustration (1988); M. Hodgson & R. Paine, *Field Guide to Australian Orchids*, p. 152 (1989); N. Hoffman & A. Brown, *Orchids of South-West Australia*, 2nd ed., p. 187 (1992) and rev. 2nd edn with suppl., 187 (1998); D. Jones & B. Jones, *A Field Guide to the Native Orchids of Southern Australia*, p. 139 (2000).

Leaf narrowly ovate to ovate, obliquely ascending, petiole dark maroon or creamy green, 2–12 mm above ground.

Specimens examined. WESTERN AUSTRALIA: Riverton, Canning, Aug. 1919, *W.B. Alexander s.n.* (PERTH00247146); Cannington, Aug. 1902, *C. Andrews s.n.* (PERTH00247103); Guildford, July 1901, *C. Andrews s.n.* (PERTH00247537); Kendenup, 6 Aug. 1931, *Anonymous s.n.* (PERTH00248002); 1 km N of Mount Heywood, 8 Aug. 1980, *A. Brown s.n.* (PERTH00293288); Mount Burdett, 1 Sep. 1984, *M.A. Burgman & C. Layman MAB 3288* (PERTH00246670); Busselton, *n.dat.*, *E. Coleman s.n.* (PERTH00270172); Busselton, Oct. 1929, *E. Coleman s.n.* (PERTH00248088); Busselton, Oct. 1929, *E. Coleman s.n.* (PERTH00247588); Youngs Siding, 12 July 1933, *R. Erickson s.n.* (PERTH00923362); Wagin, July 1924, *C.A. Gardners s.n.* (PERTH00247561); Great Northern Hwy, 30 mile peg (c. 4 km from Bullsbrook towards Bindoon on Great Northern Hwy), 28 July 1957, *A.S. George s.n.* (PERTH00917494); Bartram Rd, Jandakot, 2 Aug. 1959, *A.S. George s.n.* (PERTH00270199); Bow River, W of Denmark, 34° 58' 00" S, 116° 56' 00" E, 12 Oct. 1969, *A.S. George* 9702 (K, MEL, NSW, PERTH00247065); NE base of Mount Heywood, 33° 20' 00" S, 122° 32' 00" E, 8 Aug. 1980, *A.S. George* 15879 (PERTH00292796); SW of Mount Ney, 33° 28' 00" S, 122° 22' 00" E, 9 Aug. 1980, *A.S. George* 15924 (PERTH00292869); Mount Burdett, 33° 27' 00" S, 122° 09' 00" E, 10 Aug. 1980, *A.S. George* 15947 (PERTH00294691); S side of Boyatup Hill, 33° 44' 00" S, 123° 02' 00" E, 13 Aug. 1980, *A.S. George* 15987 (PERTH00246662); King George Sound, Apr. 1899, *B.T. Goadby* 19 (PERTH00247553); Maida Vale, Aug., *B.T. Goadby s.n.* (PERTH00247111); Albany, Aug. 1901, *B.T. Goadby s.n.* (PERTH00248045); Bayswater, Aug. 1927, *B.T. Goadby s.n.* (PERTH00270180); Maida Vale, July 1932, *B.T. Goadby s.n.* (PERTH00247138); N.I., 5 Aug. 1932, *B.T. Goadby s.n.* (PERTH00247626); Bayswater, July 1935, *B.T. Goadby s.n.* (PERTH00247049); Porongurups, Sep. 1930, *B.T. Goadby s.n.* (PERTH00248010); Bellevue, *n.dat.*, *B.T. Goadby s.n.* (PERTH00247529); Pemberton, Aug. 1928, *C. Hamiltons s.n.* (PERTH00247596); Wharton Beach, Duke of Orleans Bay, Cape Le Grand National Park, 19 July 1977, *A.J. Harringtons s.n.* (PERTH00248517); Mowen Rd, c. 5.7 km E of Great North Rd, 33° 56' 00" S, 115° 24' 00" E, 10 Sep. 1985, *S.D. Hopper* 4522 (PERTH00863866); Nillup, 1934, *L. Horburys s.n.* (PERTH00246654); Nillup, 1934, *L. Horburys s.n. (a,b)* (PERTH00242802); Alexandra Bridge, 10 Aug. 1975, *G. Hos* 20/5 (PERTH00242756); Albany, 1919, *Dr A. Syme Johnsons s.n.* (PERTH00247618); 1 km W of Kamballup to Mount Barker, 4 Aug. 1986, *G.J. Keighery* 9880 (PERTH00854654); 1 mile W of car park at Nancy Peak, Porongurups National Park, 9 Oct. 1972, *G.J. Keighery & B.J. Banyard s.n.* (PERTH00927619); Area number 209 (W.A.L.), on private land (behind Ivans farm), 18 Aug. 1965, *K.F. Kenneally s.n.* (PERTH00919152); Margaret River District, 24 July 1919, *A.H. Manns s.n.* (PERTH00247634); Mobrup, 30 Aug. 1958, *M. Marriotts s.n.* (PERTH00925535); West Mount Barren, 20 Sep. 1969,

K.R. Newbey 2895 (PERTH00248495); 11 miles SE of Ongerup, 26 Aug. 1973, *K.R. Newbey* 3721 (PERTH00248061); 2 km WSW of Nicholson and Ranford Rd junction, Jandakot, 32° 06' 00" S, 115° 52' 00" E, 28 July 1986, *R. Peakall* 110 (PERTH00847305); Beermullah, 16 miles NW of Gingin, 7 Sep. 1973, *R. Roes.n.* (PERTH00248509); Pemberton, 16 Oct. 1919, *O.H. Sargents.n.* (PERTH00270164); 1 mile from Denmark–Walpole road along Valley of the Giants road, near Bow River, 17 Sep. 1966, *E.M. Scrymgeour* 1164 (PERTH00270156); Corner of Ring Rd and Bussell Hwy, Bunbury, 22 Aug. 1972, *G. Stones.n.* (PERTH00247081); Collie, 5 Sep. 1906, *Mrs Tapps.n.* (PERTH00248053); Coomalbidgup Swamp, Ravensthorpe Rd side, 24633, Map 422/80, Aug. 1977, *D.R. Voigt* 22pp (PERTH00248037); Wittenoom Hills, 13 Aug. 1978, *D.R. Voigt* 47pp (PERTH00247073); Condingup Lookout, 13 Aug. 1978, *D.R. Voigt* 48 (PERTH00247057); E end of Mount Howick, Condingup area, 4 Sep. 1978, *D.R. Voigt* 70pp (PERTH00246646); Slope of Mount Heywood, 8 Aug. 1980, *T. Voigt.s.n.* (PERTH00293296); S of Nannup, 14 Sep. 1962, *F.W. Went* 96 (PERTH00248029).

Distribution and habitat. Wide-ranging from Jurien to east of Esperance, inland as far as York, the Stirling Range and granite outcrops such as Mt Ney. Grows predominantly in winter-wet sites except for high rainfall country where it grows in free-draining soils. (Figure 6A)

Flowering period. July to October, dependant on summer fire.

Notes. The type subspecies is a very common diminutive orchid. It is colonial, and exhibits variation in floral colour between clones, some rich pink and others white. The ovate obliquely ascending leaf held above the soil surface primarily distinguishes subsp. *scaber* from subsp. *orbifolia*.

***Eriochilus scaber* subsp. *orbifolia* Hopper & A.P. Br., subsp. nov.**

A subspeciebus *scaber* folio orbiculato plane tenentibus in terra differt.

Typus: Walpole, 3 August 1989, *S.D. Hopper* 7282 (*holo:* PERTH 1751514!; *iso:* CBG!).

Illustrations. None published. [N. Hoffman & A. Brown, *Orchids of South-West Australia*, 2nd ed., p. 188 (1992) and rev. 2nd edn with suppl., 188 (1998) – this photo is of *E. scaber* subsp. *scaber*.]

Leaf orbicular, held flat on ground, petiole creamy green, extending 1–3 mm above ground.

Specimens examined. WESTERN AUSTRALIA: Type location: 12 July 1994, *W. Jackson* BJ 287 (PERTH 4122720); 24 July 1994, *W. Jackson* BJ 286 (PERTH 4303121); 6 Aug. 1994, *W. Jackson* BJ 283 (PERTH 4303148); 12 Aug. 1994, *W. Jackson* BJ 284 (PERTH 4261909).

Distribution and habitat. Confined to undulating broad swales in coastal consolidated dunes near Walpole. Associated vegetation is *Desmocladius flexuosa* sedgeland with scattered emergent *Agonis flexuosa* or *Banksia littoralis*. (Figure 6B)

Flowering period. July to August, dependant on summer fire.

Conservation status. Conservation Codes for Western Australian Flora: Priority One. *E. scaber* subsp. *orbifolia* is highly geographically restricted, being known only from a single location west of Walpole.

The type site has been searched on a number of occasions since 1989, including after a late autumn fire, and was rediscovered in 1994 by the late Bill Jackson.

Etymology. Named from the Latin *orbifolius* (round leaf), alluding to the leaf shape of the subspecies.

Notes. *Eriochilus scaber* subsp. *orbifolia* is a poorly known taxon distinctive in its orbicular leaf held flat on the ground. Its distribution along the high rainfall south coast requires further investigation. Repeated visits to the type location over a number of years by the late Bill Jackson (pers. comm.) established that the subspecies flowers only the first year after summer wildfire.

Eriochilus tenuis Lindley, Sketch Veg. Swan Riv. Col. 53 (1840). *Typus*: Swan River, 1839, Drummond (*holo*: K-L! (Figure 7); *iso*: K!).

Eriochilus tenuis Lindley var. *robustior* H.G. Reichb., Beitr. Syst. Pfl. 62 (1871). *Typus*: King George Sound, Maxwell (*holo*: W!).

Illustrations. D. Jones, *Native Orchids of Australia*, p. 159 lower two illustrations (1988); N. Hoffman & A. Brown, *Orchids of South-West Australia*, 2nd ed., p. 186 (1992) and rev. 2nd edn with suppl., 188 (1998).

Leaf basal, narrowly ovate, shortly acute, 12–35 mm long, uniformly green on upper and lower surfaces; lamina slightly concave; margins flat. *Leaf of non-flowering plant* held flat on ground, evenly hirsute above, 12–35 mm × 5–15 mm. *Leaf of flowering plant* inserted a twentieth or less the way up scape, obliquely ascending, glabrous, same size as on nonflowering plants. *Scape* glabrous, wiry, slender, green, 10–25 cm tall. *Floral bract* broadly ovate, to 5 by 5 mm. *Inflorescence* single-flowered, rarely two. *Dorsal sepal* pale pink, 7–10 mm × 2–3 mm. *Lateral sepals* cream, often pink tinged, 7–10 mm × 3–4 mm. *Petals* appressed to column at full anthesis, with dark pink median and marginal longitudinal stripes, 4–6 mm × 2–2.5 mm. *Labellum* 6–8 mm × 3–4.5 mm; *lamina* 5–7 mm × 3–4.5 mm, prominently decurved, flattened-orbicular when viewed from front, uniformly rose pink, with dense clusters of hairs; *claw* to 4 mm long. *Column* 4–6 mm × 2–2.5 mm; stem uniformly pale green, slender (0.5–1 mm wide), tapering slightly towards base, inconspicuously winged. *Anther* uniformly dark pink except for white irregularly serrate margins. *Stigma* scarcely visible through a slender horizontal orifice; margins of orifice white, becoming dark pink elsewhere. *Ovary* brownish maroon to dark red, hairs sometimes grouped in longitudinal clusters along ribs.

Specimens examined. WESTERN AUSTRALIA: Muir Hwy, 15 Oct. 1980, A. Brown s.n. (PERTH 00247154); Between Bullcreek and Rossmoyne, 8 Oct. 1970, A.S. George 10400 (PERTH 00247545); Near source of Gingin Brook, 24 Oct. 1971, A.S. George 11145 (PERTH 00270148); Donnelly River Boat Landing, 5.5 km SSW along Landing Rd from Nannup–Pemberton road, c. 20 km W of Pemberton, 22 Oct. 1985, R. Peakall 0079 (PERTH 00561061); “Sand Springs”, near York, 8 Oct. 1919, O.H. Sargent 825 (PERTH 00248118); “Sand Springs”, near York, 8 Oct. 1919, O.H. Sargent s.n. (PERTH 00248487).

Distribution and habitat. Extends from Guildford in suburban Perth to Albany throughout the high rainfall southwest. Grows in winter-wet peaty swamps or creeklines under paperbark melaleucas. (Figure 6C)

Flowering period. September to November, dependant on summer fire.

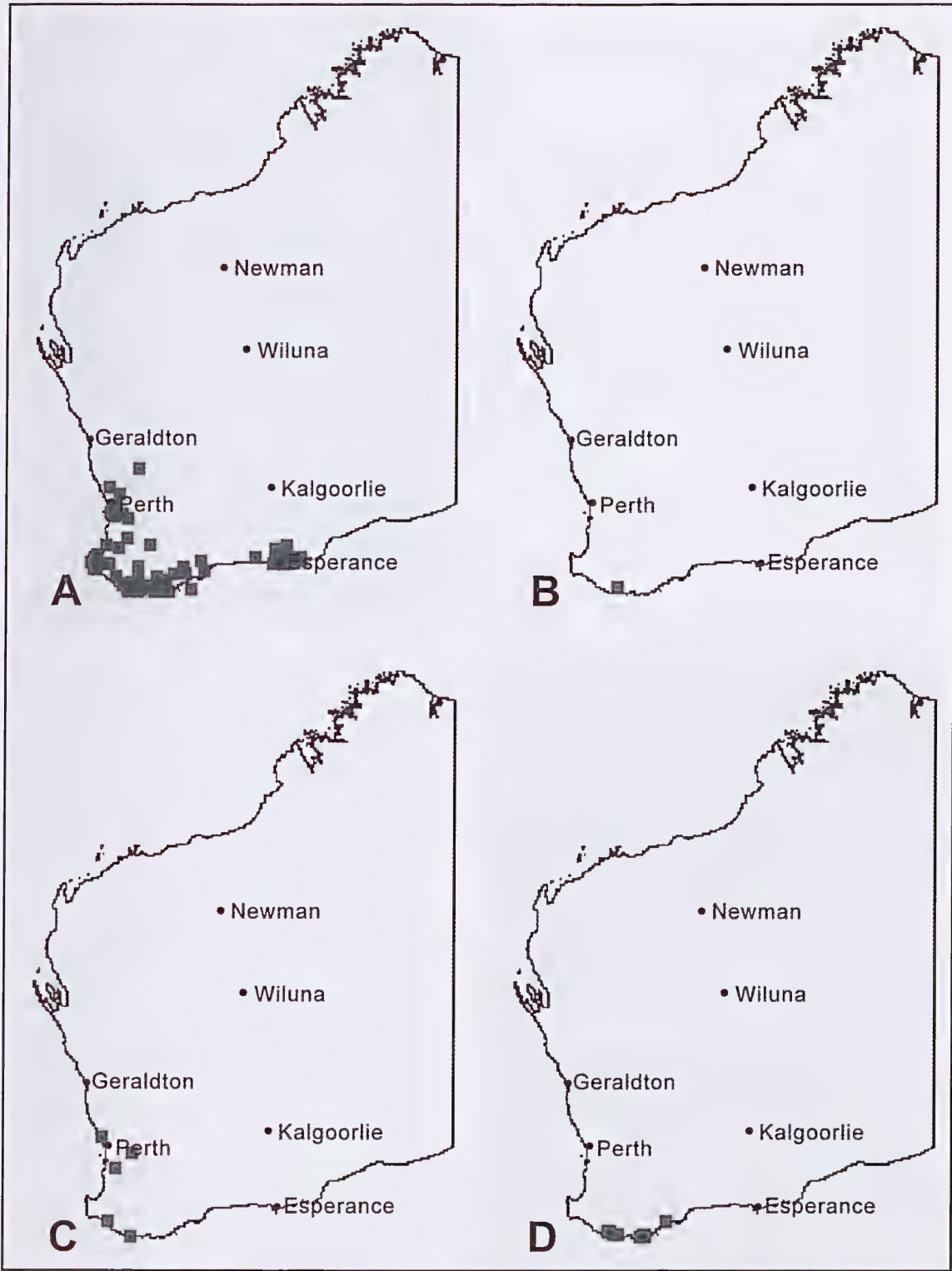


Figure 6. Distribution maps. A – *Eriochilus scaber* subsp. *scaber*; B – *Eriochilus scaber* subsp. *orbifolia*; C – *Eriochilus tenuis*; D – *Eriochilus valens*.

Notes. Until recently *Eriochilus tenuis* has received varied treatment and has been the subject of some confusion. Lindley (1840) distinguished *E. tenuis* from *E. scaber* by its less leathery elongate ovate-oblong leaf with a more obtuse apex, its more slender and taller scapes, and by its glabrous ovate bracts. Bentham (1873) accepted *E. tenuis* as a distinct species, highlighting in his key to species its narrow leaves and glabrous stems as diagnostic characters differing from the wide leaves and villous stems of *E. scaber*. Reichenbach (1871) also accepted *E. tenuis*, and named the variety *robustior*, the type of which falls within the normal range of variation of typical *E. tenuis*.

Rogers (1920) did not mention *Eriochilus tenuis* in his discussion of *Eriochilus*. Pelloe (1930) correctly diagnosed the species but gave an unlikely flowering date of May for the Guildford population. Erickson (1965) also gave a brief accurate diagnosis of *E. tenuis*, but stated that it was 'perhaps a form of *E. dilatatus*'. The latter idea was supported by Nicholls (1969) and by Cady and Rotherham (1970). Neither Erickson (1965), Nicholls (1969) nor Cady and Rotherham (1970) elaborated on why they considered *E. tenuis* might be a form of *E. dilatatus* rather than of *E. scaber*. These authors did not illustrate *E. tenuis* and presumably they had not seen fresh specimens of the species.

George (1971) regarded *E. tenuis* as a tall, slender form of *Eriochilus scaber*, and did not recognise these taxa as distinct. This view was followed by Clements (1982), Hoffman and Brown (1984), Green (1985) and Rye (1987).

Jones (1988) and Clements (1989) argued for the reinstatement of *Eriochilus tenuis*. Jones (1988) provided the more complete description, which differs from ours (above) in several respects. Jones (1988) stated that *E. tenuis* flowers from July to September (we have not seen flowers before September), the leaf is described as 'to 18 mm × 8 mm, narrow-ovate to heart-shaped, ground hugging, dark green and glabrous' (we have observed leaves to 35 mm × 15 mm, always narrowly ovate and not heart-shaped, ground hugging only in non-flowering plants, obliquely ascending in flowering plants, light green in colour, and glabrous only when flowering, evenly hirsute on the upper surface of leaves on non-flowering plants). The flowers were described by Jones (1988) as 'white', but we find that they vary from cream to pale pink. The labellum was described as 'greenish ... with stiff white hairs', whereas we have observed it to be uniformly rose pink with red hairs. Clements (1989) also claimed that the flowers of *E. tenuis* were white rather than pink, and that the species had a glabrous leaf.

Thus, we agree with Jones (1988) and Clements (1989) that *Eriochilus tenuis* should be reinstated as a species distinct from *E. scaber*, but provide here for the first time a full description of the species based on an examination of fresh and dried specimens from many localities.

We are uncertain as to the affinities of *Eriochilus tenuis*, as there are some taxa yet to be described from eastern Australia, including from peat bogs (Bates 1989; Bates and Weber 1990), and it may be that the nearest relatives of *E. tenuis* are among these.

The species differs from *Eriochilus scaber* in its leaves to 35 mm × 15 mm, always narrowly ovate and not heart-shaped, ground-hugging only in non-flowering plants, obliquely ascending in flowering plants, light green in colour, and glabrous only when flowering, evenly hirsute on the upper surface of leaves on non-flowering plants, and its more slender, glabrous and taller scapes.

Eriochilus tenuis is poorly collected and rarely seen, though locally common in our experience.

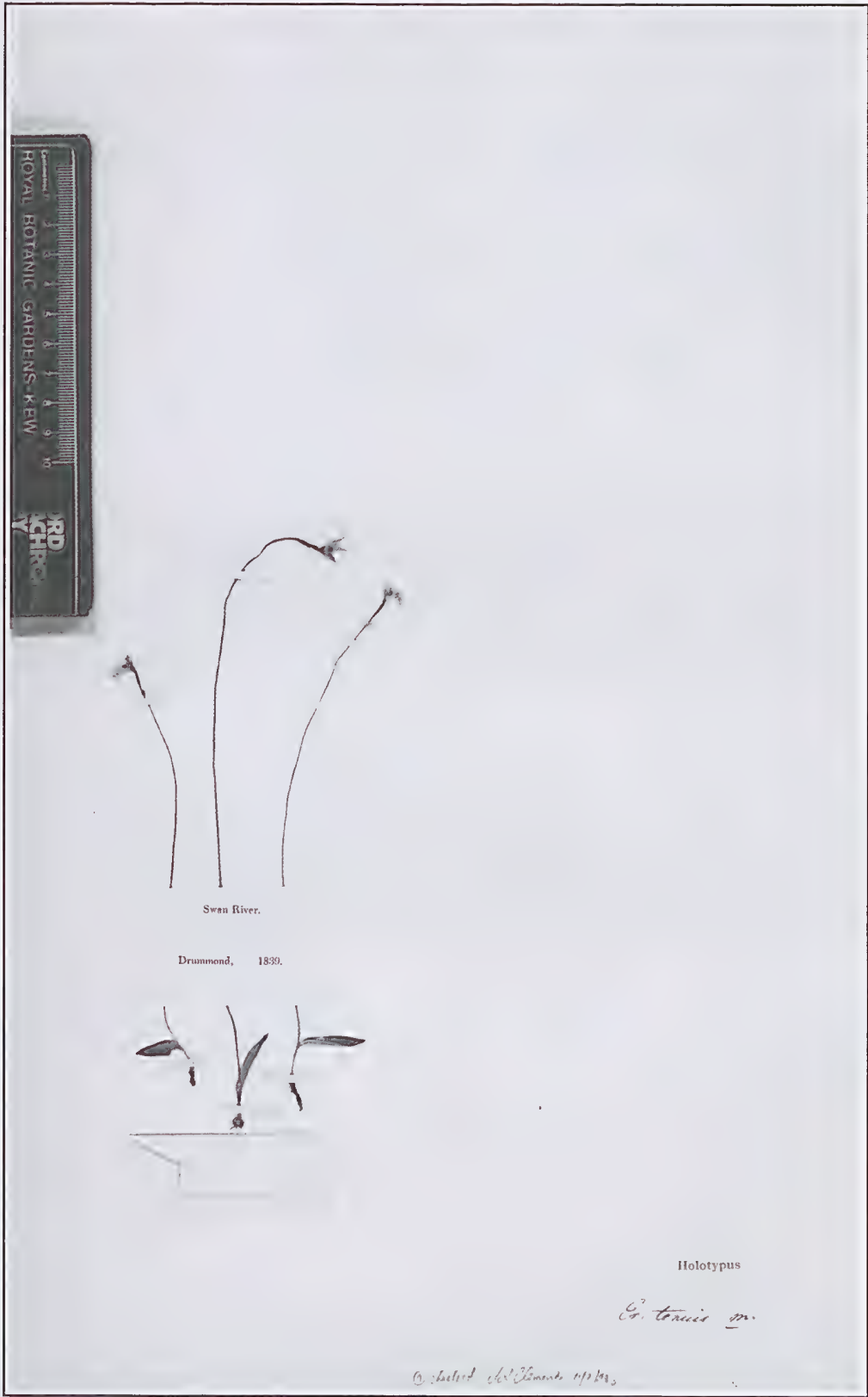


Figure 7. Holotype of *Eriochilus tenuis*. Swan River, Drummond s.n.

Eriochilus valens* Hopper & A.P. Br., *sp. nov.

A. E. dilatato R.Br. labello magno 3–6 mm lato maculatis atro purpureis differt.

Typus: Bakers Junction Nature Reserve, on the track running parallel to the E boundary, c. 50 metres W of the boundary, 34° 56' 00" S, 117° 55' 00" E, 02 May 1989, *A. Brown* 924 (*holo*: PERTH 01197266!).

Illustrations. N. Hoffman & A. Brown, *Orchids of South-West Australia*, 2nd ed., p. 184 (1992) and rev. 2nd edn with suppl., 184 (1998).

Leaf cauline, ovate, acute, 10–20 mm long, concolorous, green, underside not prominently ribbed when fresh, margins flat or slightly undulate. *Leaf of non-flowering plant* 10–20 mm long and 6–12 mm wide. *Leaf of flowering plant* inserted a quarter to a third of the way up scape, similar in size to that on non-flowering plant. *Scape* wiry, uniformly green or dark purple towards the base and green above, 10–20 cm tall. *Floral bract* ovate, to 5 × 3 mm. *Inflorescence* usually single-flowered, rarely up to 5. *Dorsal sepal* cream with dark brownish-red marginal markings, 7–10 mm × 3–4 mm. *Lateral sepals* 11–14 mm × 3–4 mm, cream, underside sometimes faintly suffused pink towards the apex. *Petals* appressed to the column at full anthesis, cream with dark brownish-red marginal longitudinal stripes, 6–9 mm × 1.0–1.5 mm. *Labellum* 8–11 mm × 3–6 mm; *lamina* 4–6 mm × 3–6 mm, prominently decurved, flattened-orbicular when viewed from front, with a central longitudinal channel and green band conspicuously devoid of coloured hairs, flanked by dense clusters of dark red hairs; *claw* 3–5 mm long. *Column* to 7 × 3 mm; stem uniformly pale green, tapering slightly towards base, winged. *Anther* dark red, creamy pink on the margins. *Stigma* clearly visible through a transversely oval orifice; margins of orifice pinkish cream, becoming dark red; lower margins with central and extreme lateral downward dips. *Ovary* green. (Figure 8)

Specimens examined. WESTERN AUSTRALIA: Hooper Rd, NE of Albany and W of Oyster Harbour, 34° 57' 00" S, 117° 56' 00" E, 2 May 1989, *A. Brown* 927 (PERTH 01197274); Loc 33307 Recreation Reserve, just N of Lake Powell on the Albany–Torbay Rd, 35° 01' S 117° 45' E, 3 May 1989, *A. Brown s.n.* (PERTH 01751506); Albany, *s.dat.*, *B.T. Goadby s.n.* (PERTH 00870455); King George Sound, Apr. 1899, *B.T. Goadby s.n. (a,b,c,d,f)* (PERTH 00242829); 0.5 km SE along track off Old School Rd, c. 10 metres E of Allan Rd, c. 15 km W of Albany, 35° 01' 00" S, 117° 44' 00" E, 4 May 1989, *S.D. Hopper* 7162 (PERTH 01197258); 7 miles N of Boat Harbour, 27 Apr. 1963, *K.R. Newbey* 746 (PERTH 00244228).

Distribution and habitat. Confined to high rainfall sites between Manjimup and Albany. Grows in low heath fringing winter-wet swamps, with *Adenanthos obovatus*, *Dasyogon bromeliifolius*, *Anarthria scabra*, *Desmodadus flexuosa*, *Beaufortia sparsa*, *Agonis parviceps* and scattered emergent marri and jarrah. Soils are sandy. (Figure 6D)

Flowering period. March to May, dependant on summer fire.

Etymology. Named from the Latin *validus* (strong, robust), alluding to the large colourful labellum of the species.

Notes. *Eriochilus valens* is a rarely seen south coastal orchid in need of further survey to establish its conservation status. It forms small clumps of up to 10 plants. It grows with *E. scaber* subsp. *scaber*, *E. helonomos* and *E. dilatatus* subsp. *multiflorus*, initially flowering earlier than the latter two, and a few months earlier than *E. scaber*. *E. valens* differs from *E. dilatatus* and *E. helonomos* in its large more colourful labellum 3–6 mm wide.

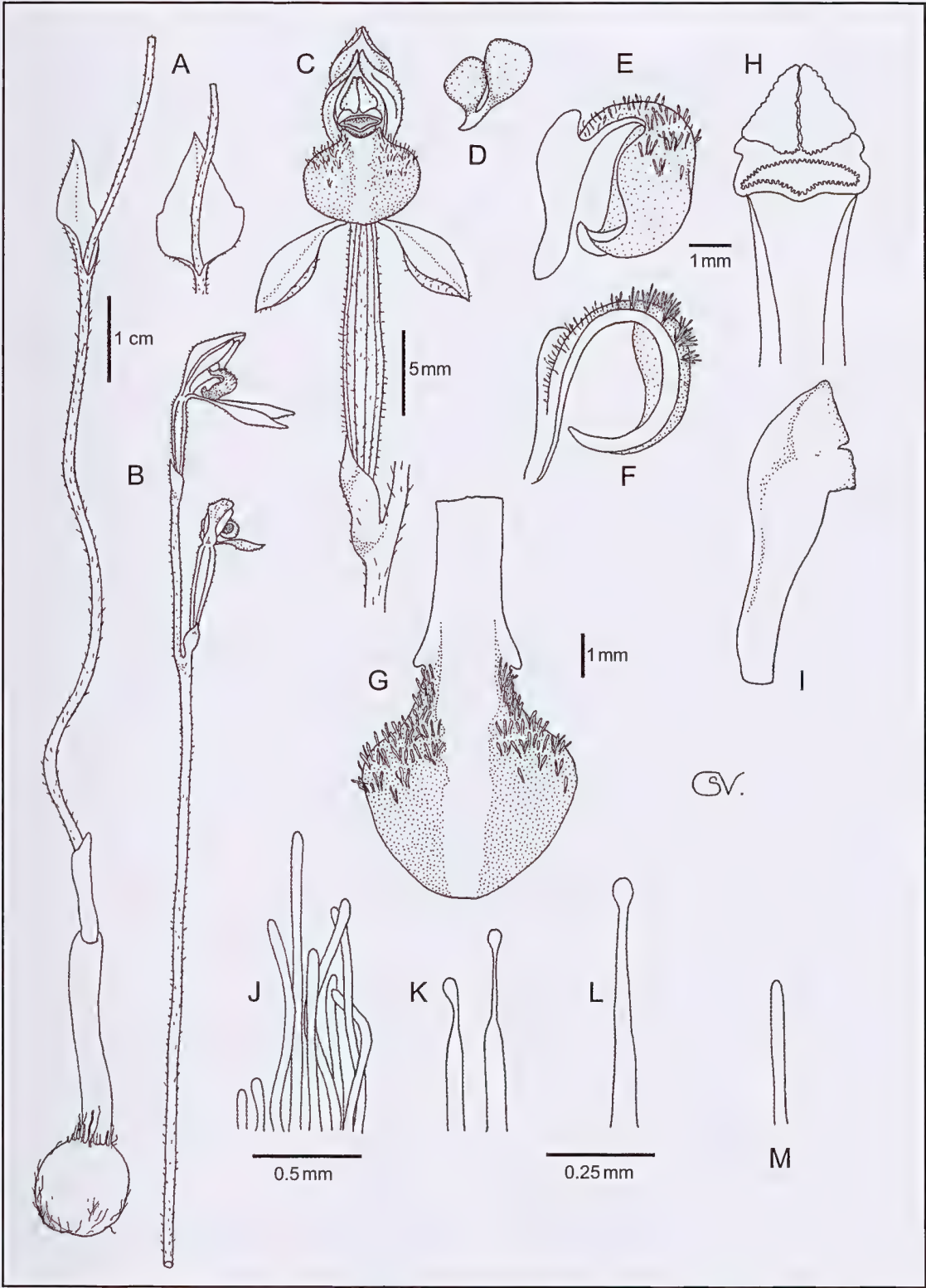


Figure 8. *Eriochilus valens* from north of Lake Powell on the Albany–Torbay Road, A.P. Brown s.n. (PERTH 01751506). A – leaf and tuber; B – flowers; C – flower from front; D – pollinia; E – labellum from side; F – longitudinally sectioned labellum from side; G – flattened labellum from above; H – column from front; I – column from side; J – labellum lamina calli; K – hairs from lower scape; L – glandular hairs on ovary; M – hairs from petals and sepals. Drawn by C. Vassilu.

Acknowledgements

We thank the staff of the Western Australian Herbarium, for access to specimens, discussion, and Paul Wilson in particular for help with Latin diagnoses. The late Bill Jackson, Chris French, Gary Brockman and Joff Start assisted in field work. Catherine Vasilu provided artwork. Cibachromes of type specimens are courtesy of the Royal Botanic Gardens, Kew. Maps are based on those in FloraBase (Western Australian Herbarium 2006).

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New species of *Xanthoria* (Teloschistaceae) from Australia

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Abstract

Kondratyuk, S.Y., Kärnefelt, E.I., & Thell, A. New species of *Xanthoria* (Teloschistaceae) from Australia. *Nuytsia* 16(1) 63–76(2006). *Xanthoria elixii* S. Kondr. & Kärnefelt, *sp. nov.* and *X. streimannii* S. Kondr. & Kärnefelt, *sp. nov.* are described, illustrated and compared with allied taxa, and a detailed description of the common and widespread species *X. filsonii* Elix is also given. A key to Australian taxa of *Xanthoria* is provided.

Introduction

The genus *Xanthoria* was recently split into two almost equally sized genera when the *Xanthoria ulophyllodes*-group was transferred to *Xanthomendoza* based on morphological, anatomical and molecular data. The genus *Xanthomendoza* has its main distribution in the northern hemisphere, whereas, after the inclusion of the *X. ulophyllodes*-group in *Xanthomendoza*, *Xanthoria* is distributed primarily in Australia and southern Africa (Søchting *et al.* 2002).

Filson (1969) included only two species in *Xanthoria*, namely *X. parietina* and *X. ligulata* (treated as *X. ectanea*) in his paper on the fruticose and foliose members of the Teloschistaceae in Australia. In an exsiccate Elix (1988) published a short description of *X. filsonii* characterised mainly on differences in the secondary chemistry. In revising *X. parietina* and *X. ligulata* from Australia, it became apparent that *X. filsonii* is rather widespread and can also be defined on morphological characters.

Even though many *Xanthoria* species have been described in recent years (e.g. Castello 1995, Giralt *et al.* 1993, Kärnefelt *et al.* 1995, Kondratyuk 1997, Kondratyuk & Kärnefelt 1997*a, b*, 2000, Kondratyuk & Poelt 1997, Kondratyuk *et al.* 2004, Lindblom 1997, Poelt & Petutschnig 1992*a, b*), several species have yet to be described from the southern hemisphere, two of which are described here as *X. elixii* and *X. streimannii*.

Materials and methods

The study presented here is based mainly on herbarium material kept in C, B, BCRU, BG, BM, CBG, GZU, H, HO, KW, LD, MEL, MIN, PERTH, S, SGO, TNS and UPS.

Fragments of lichens were sectioned with a Kryomat, Leitz freezing microtome and sections were mounted in water or in lactophenol cottonblue. Anatomical structure and hymenial characters were studied with a Zeiss Axioscope light microscope; photomicrographs were made with an Olympus DP 11 digital camera.

Extractions of secondary metabolites and HPLC analyses were made according to Søchting (1997, 2001). Quantification of the metabolites was based on absorption at 270 nm. The proportions of metabolites were calculated in relation to the total of all significant absorption peaks recorded. Thalli and apothecia were analysed separately.

Taxonomy

Xanthoria elixii S. Kondr. & Kärnefelt, *sp. nov.*

A *Xanthoria filsonii* differt lobis magis evolutis apotheciis carentibus, zonam marginalem distinctam formantibus, apotheciis majusculis in medio thalli sitis, necnon anatomia thalli et apotheciorum (vide descriptio anglica).

Typus: Western Australia: Shire of Mullewa: 62 km to Morawa, SE of Mullewa, between Tardun & Canna, 28°45'16.6" S, 115°40'20.8" E, chenopod heath (with *Atriplex nummularia* and *Casuarina obesa*). On *Atriplex nummularia*, 7 Jan. 2004, Kondratyuk, S. (20429), Kärnefelt, I. & Cranfield, R.J. (holo: PERTH 07194005; iso: CBG, KW, LD).

Thallus small, (8–)10–25(–40) mm diam., in aggregations to 4–5 cm across; plane, with distinct c. (1–)2–3 mm wide marginal zone without apothecia, central part with numerous apothecia; upper surface evenly yellow, orange-yellow to grey or whitish; lobes well developed at the margins as rounded terminal portions of dissected thallus margin (1–)1.5–2 mm deep and (0.7–)1–2(–3) mm wide, sometimes well developed, narrow and elongated 2–4(–5) mm long and (0.5–)1–2(–3) mm wide, total width of lobe with all secondary lobules (2–)3–4(–6) mm wide; slightly waved and with slightly developed marginal 'rim', loosely attached to the substrate at the marginal zone; thallus 80–110 mm thick in section; *upper cortex* thin, c. (5–)10–12(–17.5) mm, mesodermatous paraplectenchymatous; algal layer 16–20(–25) mm thick; *medulla* c. 40–50 mm thick, with single very long hyphae, c. 3 mm diam., lumina c. 1 mm diam.; *lower cortex* (7–)10–12 mm thick, mesodermatous paraplectenchymatous. *Hapters* along margins, c. 50 mm diam., c. 60 mm long. *Ascomata and ascospores*: *Apothecia* numerous, rather large, c. (1–)1.5–2.5(–3) mm diam., disk reddish or orange, mainly plane and constricted at the basis, with well developed margin; dark yellow-orange, orange to reddish orange; *thalline exciple*, 25–30 mm thick, palisade paraplectenchymatous; *true exciple* well developed in lateral part, to 30–40 mm thick in the uppermost portion, only (5–)7–15 mm thick in basal part, pseudoprosoplectenchymatous; algae in clusters below true exciple, algal cells spherical up to (8–)15–20(–27.5) mm diam.; *hymenium* (45–)50–62.5 mm high; subhymenium up to 25 mm thick; *paraphyses* c. 2.0 mm at the basis, uppermost cells widened, with oil droplets ('oil paraphyses' after J. Poelt), up to 5–6 mm diam.; asci (35–)48–50 × (10–)15–16 mm; *ascospores* small, ellipsoid to narrowly ellipsoid to sometimes slightly curved, (11–)12.5–15 × 5–7 mm [in water and 11–14(–16) × (4–)5–6.5 mm in K], septum c. (4–)5–6(–7) µm thick [in water and (4.5–)5–6(–7) mm in K]. (Figure 1)

Chemistry. Chemosyndrom A₃ (cf. Søchting 1997, 2001).

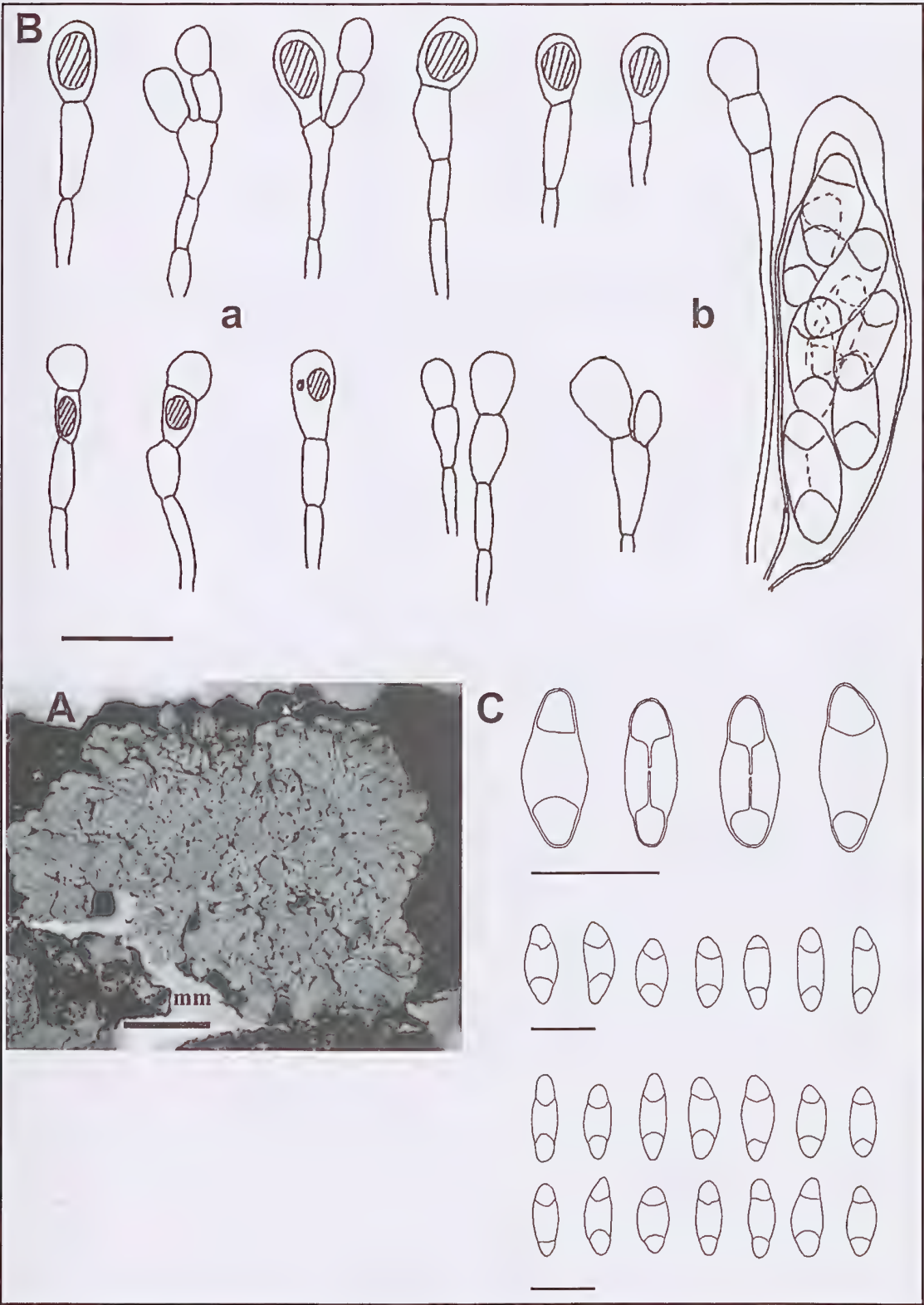


Figure 1. *Xanthoria elixii*. A – General habit (bar = 5 mm); B – (a) Paraphyses with oil droplets (= ‘oil paraphyses’, after J. Poelt), and (b) ascus with ascospores (bar = 10 µm); C – Ascospores [in K] (bar = 10 µm). Taken from Kondratyuk 20429 (holotype, PERTH 07194005).

Table 1. A comparison of distinguishing characters between some *Xanthoria* species and Australian material of *Xanthoria parietina* s. lat.

Character	<i>Xanthoria parietina</i> s.lat.	<i>Xanthoria elixii</i>
Thallus		
size diam.(cm)	to 6(–10)	to 2.5
margin	bent upwards	bent upwards
marginal vs. central parts	±different	±different
attachment	loose	loose
type	sparse, laminal hapters	sparse, marginal hapters
upper cortex	leptod.-parapl.	mesod.-parapl.
lower cortex	leptod.-parapl.	mesod.-parapl.
Lobes		
structure	concave	±concave
size	large and wide	well developed
length(mm)	3–6	1.5–2
width(mm)	2–5	1–2
Apothecia		
frequency	sparse to numerous	numerous in central part
type	±lecanorine	permanently lecanorine
true exciple	scleropl.	pseudoprosopl.
cortex of thalline margin	leptod.-parapl.	palisade parapl.
Hymenium		
paraphyses with oil droplets	present	present
Ascospores		
size(µm)	14–17×(7–)8–10	12.5–15.5×5–7
septum(µm)	(7–)8–10(–11)	5–6
Spermatia		
shape	broadly bacilliform	unknown
size(µm)	3–4×1.2–1.5	
Chemosyndrom	A	A ₃
Ecology	on various substrates	on bark or wood
Distribution	widely distributed	Australia
References	Kondratyuk & Poelt 1997; Kondratyuk 1997	present paper

Abbreviations:

leptod.-parapl. = leptodermatous paraplectenchymatous; mesod.-parapl. = mesodermatous paraplectenchymatous; parapl. = paraplectenchymatous; prosopl. = prosoplectenchymatous; pseudoprosopl. = pseudoprosoplectenchymatous; scleropl. = scleroplectenchymatous

<i>Xanthoria filsonii</i>	<i>Xanthoria dissectula</i>	<i>Xanthoria microspora</i>
to 1.5 plane similar adnate sparse, marginal hapters parapl. parapl.	to 2.5 plane different adnate short marginal rhizines palisade, parapl, or algal plectenchyma mesod.-parapl.	to 1.0 ±plane similar adnate sparse, laminal hapters parapl. parapl.
plane mostly undeveloped 1–1.5 0.5–1.5	plane small, distinctly widened towards tips 3–4(–5) 0.3–0.5 to 1–1.5	plane well developed 1.5–2.5 2–3(–5)
numerous, aggregated lecanorine to biatorine pseudoprosopl. parapl.	sparse permanently lecanorine pseudoprosopl. palisade parapl.	sparse ±lecanorine scleropl. parapl.
present	absent	absent
12–13 × 5–6 3–4.5(–6)	8–10 × 4.5–5.5 2.5–3(–5)	7–10 × 4–6 3.8–5.7
broadly ellipsoid 2.2–2.7 × 1–1.2	broadly bacilliform 3–3.5 × 1–1.5	unknown
A ₃	A ₃	?
on bark	on bark	on bark or wood
Australia	South Africa	Asia, Mediterranean, Middle East
present paper	Kondratyuk <i>et al.</i> 2004	Bouly de Lesdain 1958; Kondratyuk 2004

Selected specimens examined. WESTERN AUSTRALIA: Along Hwy Moora–Coorow, 30°34'23.5" S, 116°01'05.6" E, Chenopodiaceae communities with *Atriplex* sp., *Scaevola spinescens*, 4 Jan. 2004, Kondratyuk, S. 20411, Kärnefelt, I. & Cranfield, R.J. (KW); Railway Reserve, along the road N 116, 2 km E of Three Springs, 29°32'46" S, 115°46'42" E, 4 Jan. 2004, Kondratyuk, S. 20415, Kärnefelt, I. & Cranfield, R.J. (KW, LD); SW end of Lake Barlee, c. 19 km by track E of Diemal–Barlee Stations road, 25 Aug. 1970, Saffrey 970 (PERTH 3884031); 8 km SSE of Kalbarri, 125 km NNW of Geraldton, 1968, Wilson 6595 (MEL 32528).

SOUTH AUSTRALIA: 14.6 km from Port Neill towards Tumby Bay, near “Brayfield”, 34°11' S 136°15' E, c. 60 m, mallee along roadside, 1982, Canning, E. M. & Corbett, S. 5462 (CBG 8210165); 2 km E of Peake, along Highway 12, 35°22' S, 139°56' E, 1979, Elix, J. A. 5480 (CBG 9615593).

NEW SOUTH WALES: Willandra National Park, Halls Lake, 54 km NW of Hillston, 33°13' S, 145°03' E, 100 m alt., 30 Oct. 1987 Curnow 1566 (CBG 8705000).

AUSTRALIAN CAPITAL TERRITORY: Kambah Pool, 35°24' S, 149°00' E, c. 520 m alt., 1970, Dahl, E. s.n. (CBG 227590); Uriarra Crossing, Murrumbidgee River, 18 km W of Canberra, Wpt. 50, 35°15'03" S, 148°56'60" E, 1997, Kärnefelt, I. 9755501 (LD); Mt Ainslie, Canberra, 35°16' S, 149°07' E, 740 m alt., open *Eucalyptus* woodland on ridge. On *Bursaria spinosa*, common, 1983, Streimann 27832 (CBG 8309850).

VICTORIA: East Gippsland, Buchan Caves Reserve, 37°30' S, 148°09' E, 130 m alt., 1965, Filson 7995 (MEL 16568); NW Victoria, Sunset Country, head of McArthur's lease, 1951, Goodall s.n. (MEL 24803); NW of Swan Hill, 64 km W of Nyah West, c. 80 m alt., Wpt. 22, 35°11'69" S, 142°41'30" E, 1999, Kärnefelt, I. 992202 (LD); Buchan Caves area, on various trees in the park, 9 Feb. 2004, Kondratyuk, S. 204118 and Kärnefelt, I. (KW).

TASMANIA: Bass Strait, Furneaux Group, Cat Island, c. 20 yards E of eastern end of southern beach, 39°57' S 148°21' E, 3 m alt., 1967, Whinrays s.n. (MEL 2045054); West (Inner) Sister Island, c. 20 yards in from high water level, c. 39°42' S 147°54' E, 1966, Whinrays s.n. (MEL 1516799).

Distribution. Australia.

Ecology. *X. elixii* is a rather common corticolous species in Mangrove Swamps, coastal dunes and saltmarshes where it grows on mallee shrubs, usually on basal parts and dead sticks lying on the ground. It has been collected from twigs of *Solanum orbiculatum*, *Diplolaena dampieri*, *Atriplex padulosa*, *A. cinerea*, *A. vesicaria*, on *Melaleuca* sp., *Casuarina stricta*, *Myoporum insulare*, *Acacia dealbata*, *Casuarina cunninghamii*, *Bursaria*, *Avicennia marina*, *Hymenophora gentala*, *Callitris*, *Eremophila* sp., *Lycium ferrocissimum*, *Exocarpus*, *Olearia muelleri*, *Nitraria*, *Arthrocnemum* bush, *Muehlenbeckia cunninghamii*, *Rhagodia baccata*, and on *Sclerostegia arbuscula*. *Xanthoria elixii* has been found associated with *X. filsonii* and *Caloplaca hanneshertelii* (Kärnefelt & Kondratyuk 2004), more seldom with *Teloschistes spinosus*, *Candelaria concolor*, *Caloplaca holocarpa* agg. *Xanthoria ligulata* s.l.; *Caloplaca* cf. *gyalectoides*, *Xanthoria streimannii* and *X. parietina* s.l. Several times it has been recorded with different lichenicolous fungi e.g. *Stigmidium* sp., *Lichenodiplis poeltii*.

Etymology. This species is named in honour of the well-known Australian lichenologist Jack Elix, who has contributed extensively to improve our knowledge of the taxonomy and secondary chemistry of Australian lichens.

Taxonomy. *X. elixii* superficially resembles juvenile individuals of *X. parietina*. However, these smaller individuals usually have well developed apothecia. In terms of thallus size, the presence of marginal hapters, the distinctly developed lobes, and the lecanorine apothecia with pseudoprosoplectenchymatous true exciple, *X. elixii* reminds one of *X. streimannii* (see below). However, *X. elixii* differs from this species

in the horizontally orientated terminal portions of the lobes, the loosely attached thalli, the much shorter and concave lobes and the presence of 'oil paraphyses'. *X. elixii* also differs from *X. streimannii* by the much thinner thallus with a lax medulla, the presence of palisade paraplectenchyma in the cortex of the thalline margin, the narrower septum of ascospores, and the different secondary chemistry (chemosyndrom A₃). The lobes of *X. streimannii* are often more greyish in the central part of thallus, while the lobes in *X. elixii* are usually more evenly yellow-orange. The morphologically slightly similar and also smaller species *X. filsonii* and the Mediterranean-Asian *X. microspora* both differ from *X. elixii* in the ascending marginal zone, the mesodermatous paraplectenchymatous upper cortex, the more or less concave lobes, the presence of palisade paraplectenchyma in the cortex of the thalline exciple of apothecia, and presence of 'oil paraphyses' (see Table 1).

Xanthoria filsonii Elix, Lich. Aust. Ex. No. 174 (1988) *Type*: Australia: Victoria, Hopetoun – Patchewollock Road, 5 km NE of Hopetoun, on *Rhagodia* along grazed roadside verge with *Rhagodia* and *Eucalyptus*, 80m alt., 1987, Curnow & Lepp 1422 (*holo*: CBG, *n.v.*; *iso*: LD!, MEL!).

Thallus very small, 6–15(–25) mm across, densely adpressed, more or less covered by apothecia, yellow-orange, reddish-orange sometimes to greyish-yellow, brownish-yellow or grey; lobes less developed or invisible beyond the apothecia, occasionally seen as single separate lobes of irregular shape up to 1–1.5(–2) mm long and *c.* (0.2–)0.5–1.5(–2.5) mm wide in young thalli, irregularly elongated, mainly separate, usually unbranched, plane or flat, often with primordia, unwarted zone of lobes not wider of 1(–2) mm; thallus in section 100–110(–150) mm thick; *upper cortex* 10–12.5(–17.5) mm thick, true paraplectenchymatous; algal layer 16–20(–50) mm thick; *medulla* rather lax composed of single or groups of long horizontally orientated hyphae, 4–5(–6) mm thick, sometimes with oil droplets; *lower cortex* thin, 10–15(–20) mm thick, true paraplectenchymatous. *Hapters* rare and mainly at the marginal zone of lobes. *Ascomata and ascospores*: *Apothecia* located in central part of the thallus, usually covering the lobes, *c.* (0.4–)1–1.2(–2) mm diam., regularly rounded to irregularly pressed, disc darker reddish-orange, becoming convex and biatorine when mature. In section zeorine, *thalline exciple* paraplectenchymatous; *true exciple* up to 50–60 mm thick at the uppermost part, well developed in the basal part, 10–15 mm thick scleroplectenchymatous to somewhat pseudoprosoplectenchymatous. *Hymenium* 45–50(–60) mm high; subhymenium up to 20 mm thick, asci (45–)48–50 × 10–12 mm; *paraphyses* *c.* 2.0 mm diam., the uppermost cells up to 7 mm diam., with oil droplets; *ascospores* (10–)12–13(–16) × 5–6 mm, septum 3–4.5(–6) mm thick. *Spermatia* oblong or narrowly to widely ellipsoid, 2.2–2.7 × 1–1.2(–1.5) mm.

Chemistry. Elix (1988) reported three compounds, of which teloschistin was the major component, with parietin and parietinic acid as minor components. From our data, *X. elixii* is characterised by chemosyndrom A₃ (cf. Søchting 1997, 2002).

Selected specimens examined: WESTERN AUSTRALIA: Southern end of Lake Lefroy, 18 km NE of Widgiemooltha, 95 km NW of Norseman, 31°16'S, 121°42'E, 1996, *Archer* 291 (MEL 241326); Roe Rd from Norseman to Esperance near Beete Railway Station, *c.* 64 km SSW of Norseman, 32°42'S, 121°31'E, 1965, *Donners.n.* (MEL 16554); Coolgardie, Fraser Range, 32°01'S, 122°48'E, 1891, *Helms, R.* 40 (MEL 7438); Madura, 29 Aug. 1966, *Lowrys.n.* (PERTH 3883841); 8 miles S of Norseman, 1971, *Royce* 316 (PERTH 3883817); Eastern margin of Lake King, 1970, *Saffrey* 1210 (PERTH 3883809); Suomi Island, Pelsart Group, Abrolhos Islands, 1970, *Sammys.n.* (PERTH 3884082); 11 km NE of Cocklebidy, 1967, *Wilson.s.n.* (PERTH 3884066).

SOUTHAUSTRALIA: Koonalda Cave, 31°24'S, 129°49'E, 1965, *Beauglehole* 14951 (MEL 22828); 8 km E of Geranium along Highway 12, 35°23'S, 140°14'E, 1977, *Elix* 4137 (CBG 9507691); York Peninsula, 10 km N of Stansbury on the road to Port Vincent, Wpt. 54, 34°49.82'S, 137°49.36'E, 1999, *Kärnefelt*, I. 995401 (LD); Nullarbor, Nullarbor HS, 31°25'S, 130°54'E, 1952, *Kemsley* s.n. (MEL 7469).

NEW SOUTH WALES: South Western Plains, 15 km from Hay towards Balranald, 34°32'S, 144°43'E, 85m alt., 1988, *Butler* 1469 & *Weston* (CBG 8801506); On the Sturt Hwy 20 miles W of Balranald, 34°36'S, 143°13'E, 1970, *E. Dahls* s.n. (CBG 227589).

VICTORIA: Wimmera, Western Victoria, Horsham–Murtoa road, c. 14.5 miles from Horsham, 36°37'S, 142°22'E, 1966, *Anish* 66/611 (MEL 18270); Dimboola National Park, 36°27'S, 142°01'E, 1949, *Beauglehole* 1914 (MEL 1020491); East Gippsland, Buchan Caves Reserve, 37°30'S, 148°09'E, 130m alt., growing together with *Xanthoria elixii*, 1965, *Filson*, R. 7995 (MEL 16568); NW Victoria, Sunset Country, head of McArthur's lease, 1951, *Goodall* s.n. (MEL 24803).

TASMANIA: Bass Strait, Furneaux Group, West Sister Island, 39°42'S, 147°54'E, 1966 *Whinrays* s.n. (MEL 1516799).

Distribution. *X. filsonii* was until now known exclusively from type locality at Pink Lake in NW Victoria, however, is in fact rather widely distributed in Australia.

Ecology. *X. filsonii* is a corticolous species which has been found growing in open areas, grazing lands, in saltmarsh sites, and on shrubs near the sea. Furthermore it has been found on dead wood and bark of various trees and shrubs such as *Hymenanthera dentata*, *Atriplex cinerea*, *Eucalyptus largiflorens*, *Nitairia schoberi*, *Leucopogon parviflorus*, *Arthrocnemum* sp., *Ptilotus* sp., *Atriplex* sp., *Muehlenbeckia cunninghamii*, *Bursaria* sp., *Myoporum* sp., *Arthrocnemum* sp., *Lycium australe*, *Melaleuca* sp., *Enchylena tomentosa*, *Sclerostegia arbuscula*, *Scaevola crassifolia* and on *Acacia*. *Xanthoria filsonii* has been found growing together with *X. parietina*, *X. elixii*, *X. streimannii*, and with various species of *Caloplaca* (*C. citrina*, *C. cerina* agg., *C. holocarpa* agg., *Caloplaca* cf. *gyalectoides*), *Lecanora*, *Rinodina*, *Lecidella* spp., *Candelariella* spp., *Physcia* spp. etc.

Taxonomy. *X. filsonii* was hitherto distinguished from *X. parietina* merely by its chemosyndrom (Elix 1988). However, the material studied here revealed separating morphological characters between *X. filsonii* and *X. parietina* and other related species (Table 1). *X. filsonii* differs from *X. parietina* by its smaller size, small, flat and closely attached lobes, and presence of chemosyndrom A₃. The lobes in *X. parietina* are longer than 3 mm, with concave with undulate margins, slightly bent upwards. *X. filsonii* also reminds one of *X. polycarpa* from the boreal regions in the northern hemisphere, and of the Mediterranean species *Xanthomendoza concinna* and *X. aphrodites* in terms of the rather small size and the densely aggregated apothecia in the central parts of the thallus. *Xanthoria filsonii* differs from *X. polycarpa* in the flatter thallus in the central part, and the generally larger more closely attached lobes; furthermore, the lobes of *X. filsonii* are always flat, not dissected and usually straight and horizontally orientated.

Material of *X. filsonii* frequently included *X. ligulata* s. l. in earlier works, the latter a species of several maritime, epilithic taxa with uncertain taxonomical status, characterized by thick convex lobes forming a network-like thallus. The upper cortex of *X. ligulata* is palisade plectenchymatous, whereas it is mesodermatous paraplectenchymatous in *X. filsonii*. Furthermore, hapters in *X. filsonii* are rare and found exclusively at the lobe margins, a type of attachment characteristic of some additional *Xanthoria* species distributed in the Southern Hemisphere, such as *Xanthoria karroensis* (*Kärnefelt et al.* 2002), *X. dissectula* (*Kondratyuk et al.* 2004) and others.

Table 2. A comparison of distinguishing characters between some Australian *Xanthoria* species and Australian material of *Xanthoria parietina* s. lat.

Character	<i>X. parietina</i> s.lat.	<i>X. streimannii</i>	<i>X. ligulata</i>
Thallus			
size diam. (cm)	to 6(–10)	to 2.5	to 3–4
margin	bent upwards	horizontal	horizontal
marginal vs. central parts	±different	the same	sometimes different
attachment	loose	densely	densely
type	sparse laminal hapters	sparse marginal hapters	sparse marginal hapters
upper cortex	leptod.-parapl.	leptod.-parapl.	palisade parapl.
medulla	lax	dense	dense
lower cortex	leptod.-parapl.	leptod.-parapl.	parapl.
Lobes			
structure	concave	subconvex	convex
size	large and wide	well developed at the margins	well developed at the central part
length (mm)	3–6	3–4	10–14
width (mm)	2–5	1–1.5(–2.5)	0.7–1.5(–2)
Apothecia			
frequency	sparse to numerous	numerous in the central part	sparse to numerous
true exciple	scleropl.	pseudoprosopl.	pseudoprosopl.
cortex of thalline margin	leptod.-parapl.	parapl.	parapl.
Hymenium			
paraphyses with oil droplets	present, abundant	absent	present, abundant
Ascospores			
size (µm)	14–17 × (7–)8–10	13–15 × 6–8	11–13 × (6–)7–8
septum (µm)	(7–)8–10(–11)	6–7.5	(3–)5–6(–7)
Spermatia			
shape	broadly bacilliform	unknown	widely ellipsoid
size (µm)	3–4 × 1.2–1.5		?
Chemosyndrom	A	A	?
Ecology	on various substrates	on bark of trees or on wood	on rocks
Distribution	Widely distributed	Australia	Australia
References	Kondratyuk 1997; Kondratyuk & Poelt 1997	present paper	present paper

Abbreviations:
leptod.-parapl. = leptodermatous paraplectenchymatous; mesod.-parapl. = mesodermatous paraplectenchymatous;
parapl. = paraplectenchymatous; prosopl. = prosoplectenchymatous; pseudoprosopl. = pseudoprosoplectenchymatous;
scleropl. = scleroplectenchymatous

Xanthoria streimannii* S. Kondr. & Kärnefelt, *sp. nov.

A similibus *Xanthoria filsonii* et *X. elixii* differt thallo crasso parvo, zona marginali dissecta lobisque latioribus.

Typus: Arranda Oval, Belconnen, Canberra, ACT, 35°15'15" S, 149°04'43" E, 650m alt., on introduced roadside trees, 5 Feb.2004, *Kondratyuk, S.* 204103 (*holo*: CBG; *iso*: LD, KW, MEL, PERTH).

Thallus small, (10–)15–25(35) mm across, plane, closely adpressed to the substrate, rather thick, with marginally wrinkled lobes, upper surface yellowish-green, brownish-yellow to greyish-yellow, yellow-grey or almost whitish-grey, in the central part, to brightly yellow within the same thallus; underside white to yellowish at the margins which are slightly bent downwards, with short furcate hapters along the margins; lobes undeveloped in the central part, visible between dissections of thalline edge or between wrinkles of peripheral parts, (1–)3–4(–5) mm long and 1–1.5(–2.5) mm wide, irregularly branched; thallus in section 110–137.5 mm thick; *upper cortex* leptodermatous paraplectenchymatous; algal layer 37–47 mm thick; *medulla* rather dense; *lower cortex* leptodermatous paraplectenchymatous up to 15 (–20) mm thick. *Ascomata* and *ascospores*: *Apothecia* (0.4–)0.8–2.0 mm diam, abundant in central parts, thalline margin concolorous with thallus or slightly darker in the peripheral zone of thallus, disk yellow-orange, plane to undulating in dense aggregations, concave or plane; *hymenium* to 50–70 mm high, *true exciple* pseudoprosoplectenchymatous, up to 7.5–12 mm thick in basal part, and to 60 mm in the uppermost lateral portion; *thalline exciple* paraplectenchymatous with thickened cell walls, 20–28(30) mm thick; *paraphyses* c. 1.8–2 mm diam., the uppermost cells widened c. 5.5(–6) mm diam.; *asci* c. 48 × 14 µm; *ascospores* with wide lumina, (12.5–)13–15 × (5.5–)6–8 mm [in water and (11–)12–15(–17) × (5–)5.5–7 mm in K], septum (5–)6–7.5 mm [in water and (5–)6–9(–11) mm in K]. (Figure2)

Chemistry. *X. streimannii* is characterised by chemosyndrom A (cf. Søchting 1997, 2001).

Selected specimens examined: AUSTRALIAN CAPITAL TERRITORY: Griffith, 2 km S of Canberra 35°18'S, 149°09'E, 580m alt., 1979, *Streimann, H.* 7552 (CBG 7907173); Mt Ainslie, Canberra, 35°16'S, 149°07'E, 740m alt., 1983, *Streimann, H.* 27832 (CBG 8309850); Kingston, 4km SE of Canberra, 35°20'S, 149°08'E, 560m alt., on exotic trees, 14 Mar. 1981 *Streimann, H.* 15274 (CBG 8101702); Casuarina Sands, 16km W of Canberra, 35°20'S, 148°57'E, 500m alt., 26 Nov. 1980, *Verdon, D.* 4856 (CBG 8110518); Hawker, 10km NW of Canberra, 35°14'S, 149°02'S, 600m alt., on trunk of exotic tree at Belconnen High School, 22 Jun. 1980, *Streimann, H.* 10356 (CBG 8004567).

NEW SOUTH WALES: Lake Mulwala, W of Corowa along Murray River, c. 130m alt., Wpt. 19, 36°53'6"S, 147°18'17"E, 1999, *Kärnefelt, I.* 991901 (LD); 90 km S of Sydney, Kiama, center of town, Wpt 46, 1997, *Kärnefelt, I.* 9755101 (LD); Tea Tree Creek near Tinderry, 35°42'S, 149°15'E, 1970, *Dahl & McVean* (CBG 227486); Mountain Ck, "Brooklyn station". 35°04'S, 148°50'E. alt. 460m, 16 Feb. 1975, *Burmeister, J.* 67 (CBG 58712); Bermagui Point, on bark of Araucarias not far from the oceanic coast, 29 Jan.2004, *Kondratyuk, S.* 20484 & *Kärnefelt, I.* (KW); Jindera, 15 km NNW of Albury, 35°57'33.1"S, 146°53'28.1"E, a. 235 m alt., on roadside trees (including *Fraxinus excelsior*) in settlement, 7 Feb.2004, *Kondratyuk, S.* 204109 & *Kärnefelt, I.* (KW).

TASMANIA: Campbell Town, The Willows Picnic Reserve, Wpt. 78, 41°55.68'S, 147°27.75'E, 1999, *Kärnefelt, I.* 997801 (LD); N of Hobart along A1, c. 1 km N of Oatlands, Wpt 71, 42°17.42'S, 147°23.05'E, 1999, *Kärnefelt, I.* 997101 (LD).

VICTORIA: South Yarra, S.E. 1, Rear of Williamstown Racecourse, Victoria, 1942, *Bibby s.n.* (CBG 132563); Melbourne, South Yarra, Botanical Garden, near 'Temple of the Winds' and 'Plant Craft Cottage', 15 Feb.2004, *Kondratyuk, S.* 204134a (KW).

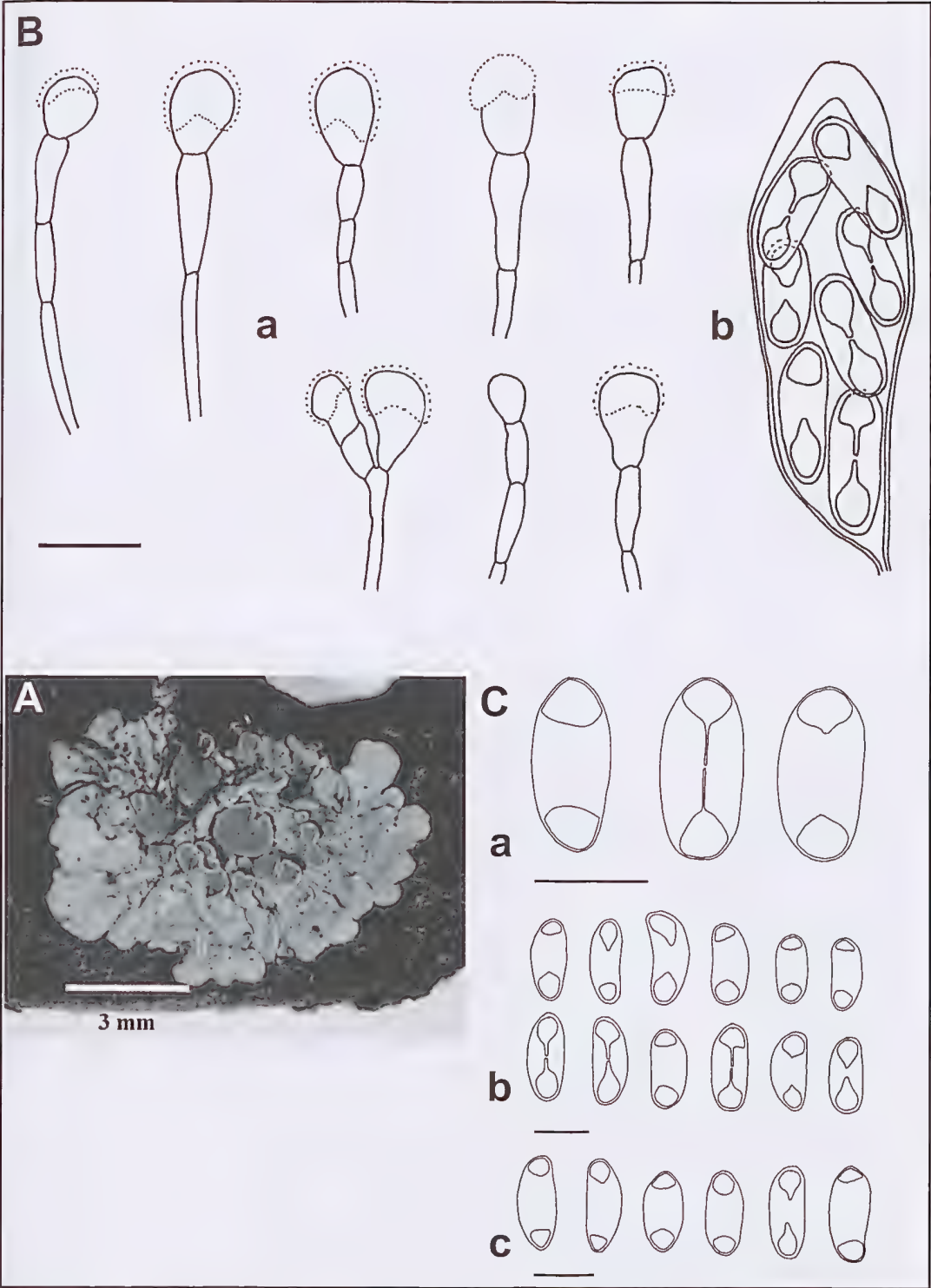


Figure 2. *Xanthoria streimannii*. A – General habit (bar = 3 mm); B – (a) Paraphyses, and (b) ascus with ascospores (bar = 10 μ m); C – Ascospores [a and c – in K; b – in water] (bar = 10 μ m). Taken from Kondratyuk 204103 (holotype, CBG).

Ecology. *X. streimannii* is a corticolous species which has been found growing on bark of various trees, particularly introduced trees such as *Crategus*, *Ulmus*, *Salix* and *Araucaria araucariana*, and on *Arthrocnemum* in salt marsh, on trunks of exotic trees between dual carriage ways, in open *Eucalyptus* woodland on ridge, and on *Bursaria spinosa*. *X. streimannii* has been found in association with *Candelaria concolor* and *Candelariella* sp. It is often damaged by lichenicolous fungi.

Etymology. This species is named after the deceased Australian bryologist Heinar Streimann, whose contribution to lichenology was of great importance through his huge and well prepared collections of mainly Australian lichens.

Taxonomy. *X. streimannii* reminds one of *X. elixii* in thallus size, well developed lobes, lecanorine apothecia, a pseudoprosoplectenchymatous true exciple, its ecology and distribution restricted to the Southern Hemisphere. However, *X. streimannii* differs from *X. elixii* by a much thicker thallus including a well developed and rather dense medulla, the subconvex lobes, thicker septa in the ascospores, and presence of chemosyndrom A. Furthermore, *X. streimannii* differs from *X. elixii* in the densely attached thallus, longer lobes, lacking upwardly bending terminal portions, and absence of 'oil paraphyses'. *X. streimannii* differs from small sized species, such as *X. filsonii* and the Mediterranean-Asian *X. microspora*, by a thicker thallus with dense medulla, subconvex, much larger lobes, and larger ascospores with wider septa. *X. filsonii* is, in contrast to *X. streimannii*, characterized by numerous, biatorine apothecia, 'oil paraphyses' and chemosyndrom A₃ (Tables 1 and 2).

Key to Australian xanthorioid lichens

1. Thallus lobes thin, concave or plane, but never convex or subconvex 3
1. Thallus lobes thick, smooth, terminal lobes slightly convex and deflexed 2
2. Thallus lobes rather longer (5–10 mm long) and narrow;
usually on coastal rocks *X. ligulata*
2. Thallus lobes visible only at dissected margin, up to 2.5(–4) mm long,
thallus c. 2–3(–5) cm diam., of very well developed circles, rosettes;
widespread on bark of trees *X. streimannii*
3. Thallus rather large, more than 2 cm diam. usually 4–6(–9) cm across,
lobes concave with raised, flexuose margins, attached only by
central part with hapters *X. parietina*
3. Thallus rather small, less than 2 cm diam., in aggregations of several thalli
more than 3 cm across, lobes horizontally orientated towards tips, attached
mainly by marginal zones 4
4. Thallus of irregular, mainly single lobes, which are mostly undeveloped or
seen only in young thalli; thallus reddish-orange, mainly of densely
aggregated apothecia; discs of apothecia non-concolorous with the thallus,
usually becoming convex and biatorine when over-mature *X. filsonii*
4. Thallus with well developed marginal zone, up to 1 cm wide always without
apothecia, lobes well visible, never completely covered by apothecia;
thallus yellow to yellow-orange with apothecia characteristically grouped
at the central part, disc plane, lecanorine and stipitate in mature stage,
concolorous with thallus or orange *X. elixii*

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Prof. Mark Seaward (Bradford, UK) is thanked for correcting the English and useful comments on a draft of this paper. SK received financial support from Wenner-Gren Foundation and STCU, IK received financial support from Crafoordska Stiftelsen and Magn. Bergvalls Stiftelse, their contributions are very much appreciated. Prof. J. Elix (Canberra, ACT) and U. Søchting (Copenhagen, Denmark) are thanked for data on chemistry of taxa studied. SK is thankful to Prof. I. Kärnefelt for his invitation to participate in an expedition to Australia, to Dr N. Marchant and D. Marchant (Como, WA), Ray J. Cranfield (Manjimup, WA), Prof. J. Elix, Dr P. McCarthy (Canberra, ACT) and Dr R. Filson (Booral, NSW) for their help with organizing excursions to the most interesting botanical localities, to Dr N. Marchant and D. Marchant, Prof. J. Elix, Dr. R. Filson and J. Filson for their warm hospitality and all kinds of support during our trip to Australia, and to Dr N. Marchant, Prof. J. Elix, and Dr Katy Sommerfield (Melbourne, Vic.) for sending specimens collected during fieldwork.

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**A new species of *Tribonanthes* (Haemodoraceae)
from saline wetland margins in Western Australia**

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Abstract

Lyons M.N. and Keighery, G.J. A new species of *Tribonanthes* (Haemodoraceae) from saline wetland margins in Western Australia. *Nuytsia* 16(1):77–80 (2006). A new species, *Tribonanthes minor*, is described and illustrated. The new species is confined to the sandy margins of primary saline lake systems in southern Western Australia.

Introduction

The paleodrainage systems of the south-west of Western Australia contain a complex array of plant habitats associated with chains of naturally saline wetlands. Current detailed studies by the Western Australian Department of Environment and Conservation (DEC), as part of the biological survey of the South-West Agricultural Zone, have confirmed the high botanical values of these areas and shown that the paleodrainage systems contain a vascular flora of over 750 species, many of which are endemic. There are many undescribed and often newly collected species in this group. This distinctive new endemic was collected during part of this survey and is considered at risk from hydrological change.

The genus *Tribonanthes* Endl. is a small genus in the Haemodoraaceae (subfamily Conostylidoideae, tribe *Tribonantheae*) comprising six species, all of which are endemic to Western Australia. It is distinguished from other genera in the Conostylidoideae by having wholly enclosed anthers and a conical corolla tube with minute erect corolla lobes.

Taxonomy

Key to species of *Tribonanthes* (after Macfarlane, 1987, p. 131).

- 1. Perianth lobes strongly reflexed
 - 2. Inflorescence 3–7 flowered **T. brachypetala**
 - 2. Inflorescence a single flower **T. minor**
- 1. Perianth lobes spreading or erect
 - 3. Perianth lobes glabrous except ciliate margins, lobes erect at anthesis **T. purpurea**
 - 3. Perianth lobes sparsely hairy to woolly hairy, lobes spreading at anthesis

4. Flowers 2–7 per inflorescence
 5. Filament appendage about level with or much exceeding anther tip; longest flower bearing branch of inflorescence 2–15 mm long from axil to flower base; perianth lobe length: maximum width ratio usually less than 3 **T. australis**
 5. Filament appendage usually shorter than anther tip; longest flower bearing branch of inflorescence 11–60 mm long from axil to flower base; perianth lobe length: maximum width ratio usually more than 3 **T. longipetala**
4. Flowers solitary
 6. Flower partially enclosed by 2 broad bracts; perianth lobes 4.5–6.5 mm long **T. violacea**
 6. Flower not partially enclosed by 2 bracts; perianth lobes 8.5–14 mm long **T. longipetala**

Tribonanthes minor M. Lyons & Keighery, *sp. nov.*

Ab *Tribonanthes violacea* differt a lobiis perianthii reflexis et subroseis–purpureis. Inflorescentia uniflora, unibractearia, ovata, rosea–purpurea.

Typus: Chinocup Nature Reserve, near Lake Chinocup, 3 kilometres south of intersection of Chinocup and Tees Rd, 33° 30' S, 118° 23' E, 18 Oct. 2000, *M.N. Lyons* 2734 (*holo*: PERTH 07245890; *iso*: CANB).

Herb annually renewed from a white ovoid tuber, 6–7 mm wide covered by numerous old tunics, 15–25 mm below surface. *Plant* 3–4 cm tall, consisting of a single scape with 10–14 mm below main leaf on soil surface. *Scape* glabrous between leaf and inflorescence bract, c. 4 mm, then woolly hairy above bract for 10–13 mm. *Leaf* green, glabrous, 20–45 mm long, spreading to erect. *Inflorescence* bract stem clasping, red–purplish, glabrous, free section, c. 4 mm long, spreading. *Inflorescence* a solitary flower, white woolly hairy outside, subtended by a single ovate, pinkish–purple bract with an acute apex, 4–5 mm long. *Flowers* not noticeably fragrant. *Ovary* 4–5 mm long. *Perianth lobes* strongly reflexed, 1–1.5 mm long, less than 1 mm wide, narrowly ovate–elliptic, woolly hairy outside, red–purplish, glabrous inside. *Filament appendage* large, fleshy, not deeply grooved on back, exceeding anthers. (Figure 1)

Other specimens examined. WESTERN AUSTRALIA: Western side of Lake King, 24 Oct. 2000, *M.N. Lyons* 2735 (PERTH), Chinocup Nature Reserve, near Lake Chinocup, 19 Oct. 1999, *M.N. Lyons* 2929 (PERTH).

Distribution and habitat. Known from scattered locations within the Avon and Mallee Bioregions of south-west Western Australia (Thackway & Cresswell 1995). Occurs on seasonally wet, low sandy rises, at the margins of saline lakes.

Flowering period. Flowers from August to September. Nearly mature capsules present in October, old capsules in December.

Conservation status. Occurs at very low elevations on the margins of naturally saline lakes. Habitat is threatened by the increased risk of flooding associated with changes in catchment hydrology following agricultural clearing. Conservation Codes for Western Australian Flora: Priority Three.

Etymology. Specific name from the Latin *minor*, meaning smaller, a reference to the very small flowers and perianth lobes of this species.

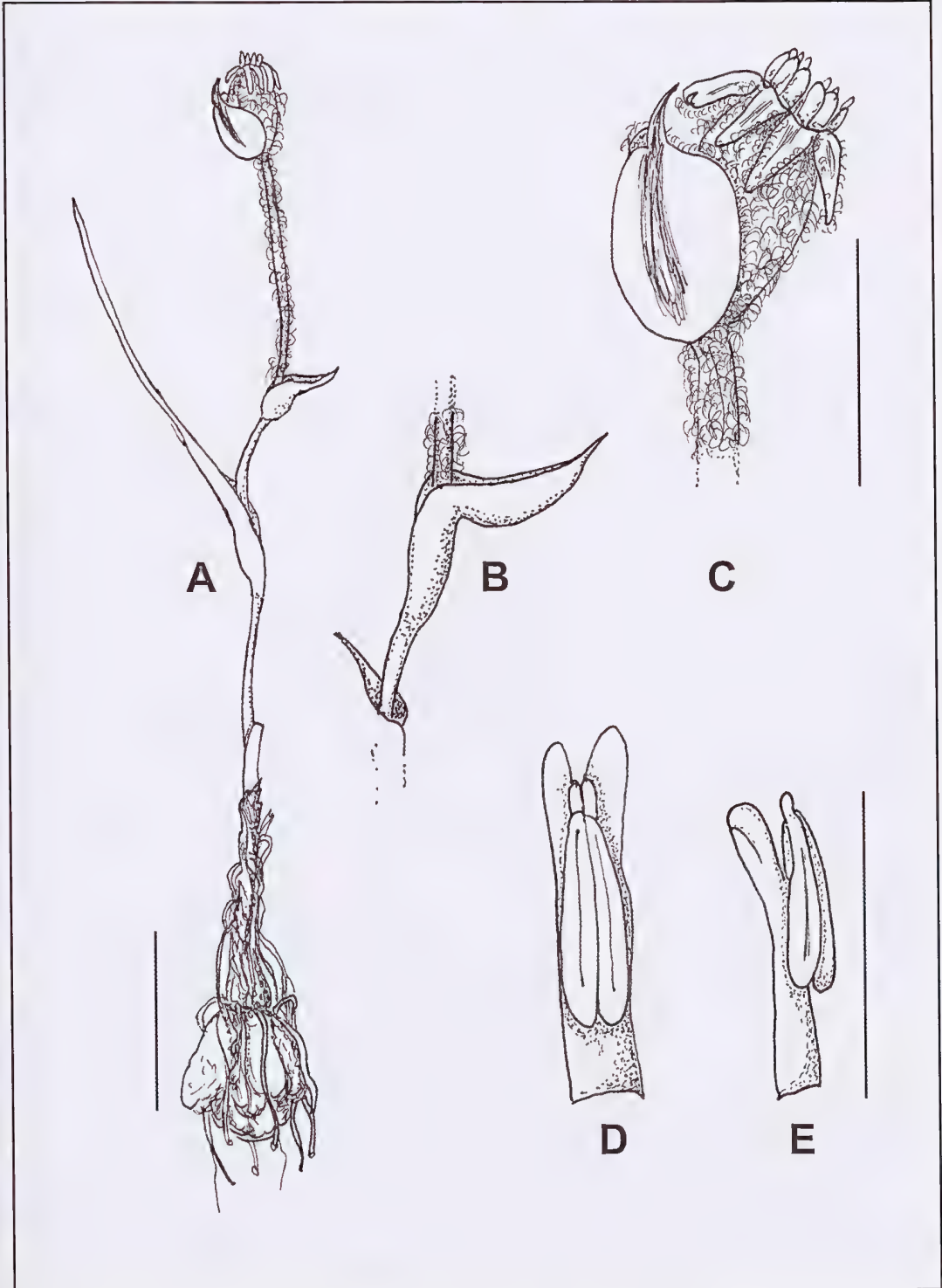


Figure 1. A–E: *Tribonanthes minor*. A – whole plant (scale bar = 1 cm); B – inflorescence bract, C – flower (scale bar = 0.5 cm); D – front view of anther, E – side view of anther (scale bar = 0.2 cm). Drawn from Lyons 2734 (PERTH 07245890).

Affinities. This species resembles *Tribonanthes brachypetala* Lindl. in having reflexed perianth lobes and large conspicuous filament appendages. However, it differs markedly from this species in the very reduced stature of the plants, the small solitary flowers with red–purple perianth lobes and flowers that are not strongly fragrant. In these characteristics it appears most closely related to *Tribonanthes violacea* Endl. However, it differs markedly from this species in having reflexed perianth lobes, a single floral bract and the small perianth lobes, 1–1.5 mm long versus 4.5–6 mm long.

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Acacia splendens (Leguminosae : Mimosoideae), a new rare species from near Dandaragan, Western Australia

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Abstract

Maslin, B.R. and Elliott, C.P. *Acacia splendens* (Leguminosae : Mimosoideae), a new rare species from near Dandaragan, Western Australia. *Nuytsia* 16(1): 81–86 (2006). A new species, *Acacia splendens* Maslin & C.P. Elliott, is described and illustrated. It is most closely related to *A. microbotrya* Benth. and *A. daphnifolia* Meisn. and is geographically restricted to near Dandaragan, Western Australia. *Acacia splendens* is Declared Rare Flora (ranked as Endangered) under the Western Australian Wildlife Conservation Act 1950 and is also listed as Endangered under Commonwealth legislation.

Introduction

Based on records at the Western Australian Herbarium (PERTH) the first collection of the rare species described below as *Acacia splendens* was made by S.J. Green in 1917 from 'Dandaragan'. No further collections occurred (or at least, none preserved at PERTH) until the early 1980's when the species was brought to the attention of the first author by Mr Alf Popplewell, the plant having been collected by Alf's nephew, Peter Popplewell, in 1981. Popplewell was a farmer and an enthusiastic naturalist with a strong conservation ethic who lived in the Dandaragan area and it was through his initial efforts that the very restricted natural geographic distribution of the species became known. In 1989 *A. splendens* was officially gazetted as a Declared Rare Flora, under the name '*Acacia* sp. Dandaragan (*S. van Leeuwen* 269)'. It was included in the *Flora of Australia* treatment as '*Acacia* sp. D' (Maslin 2001a) and as '*Acacia* affin. *microbotrya*' on the accompanying WATTLE CD (Maslin 2001b).

Acacia splendens is a member of the Australia-wide, informal '*Acacia microbotrya* group' (Maslin 1995: 186). Its relationship to presumed closest relatives within this group has been investigated using both allozyme and Random Fragment Length Polymorphism (RFLP) molecular techniques. The allozyme data shows *A. splendens* as clearly distinct from *A. microbotrya* Benth. and *A. daphnifolia* Meisn. (syn. *A. microbotrya* var. *borealis* E. Pritzel, *vide* Maslin in prep.) based on genetic distance ($D = 0.078 \pm 0.009$) and the existence of high genetic differentiation ($F_{ST} = 0.22$) (Elliott *et al.*, 2002). A canonical variate analysis of floral and phyllode characters which was conducted as part of this genetic study supported the separation of *A. splendens* from its two relatives. Similarly, a nuclear RFLP study by Byrne *et al.* (unpublished) showed *A. splendens* to be distinct from *A. microbotrya* and *A. daphnifolia*, and from another close relative, *A. amblyophylla* F. Muell.

Based on the above results and from our examination of both herbarium material and plants in the field it is clear that the taxon warrants description, and recognition at the species level seems most

appropriate. *Acacia splendens* is known from just one (large) population which is located in the vicinity of Dandaragan, Western Australia. The area in which the species grows has been extensively cleared for agriculture and it is not impossible that it once had a wider geographic distribution.

Taxonomy

Acacia splendens* Maslin & C.P. Elliott, *sp. nov.

Frutex vel arbor 1–8 m alta. Ramuli glabri, pruinosi. Phyllodia multi-variabiles, (6–)8–12 cm longa; phyllodia juvenales elliptica vel obovata, plerumque 3–6(–8) cm lata, l:w = 1.5–2(–3), ± undulata, rotundata–obtusa; phyllodia matura anguste elliptica vel oblanceolata, plerumque 1–3 cm lata, l:w = 4–8, sub-acuta vel acuminata. Inflorescentiae plerumque racemosae; axes racemulorum (1.5–)2.5–8(–15) cm longi, glabri vel sparse vel moderate appresse pallido aureo tomentosi; pedunculi (3–)4–6(–8) mm longi, indumento ut in axe racemulorum; capitula obloidea vel globularia, aurea, gloriosa, dense (33–)40–60(–75)-flora. Bracteolae spatulatae vel sub-peltatae, 1–1.5 mm longae; laminae fimbriolatae pilis flavis. Flores 5-meri; calyx longitudine $\frac{3}{4}$ corollae aequantia, gamosepalus, minime vadose dissectus. Legumina anguste oblonga, (7–)8–10(–12) mm lata, glabrum, variabile pruinosa. Semina longitudinalia obliqua in legumen, oblonga vel elliptica vel circularia, 4–6 mm longa, 3–5 mm lata, applanata, ex parte vel omnino per funiculo circumdata.

Typus: NE of Dandaragan, Western Australia, 16 May 1986, B.R. Maslin 6025 (*holo*: PERTH 00720526; *iso*: K).

Somewhat spindly, open, craggy *shrubs* 1–4 m tall, maturing to erect or spreading *trees* 5–8 m (may reach 10 m in cultivation), single-stemmed or sometimes with up to c. 4 main stems arising from ground level, stems to about 20 cm dbh (on oldest trees, commonly 4–8 cm at ground level on mature shrubs) and sub-straight to crooked; commonly spreading by root suckers. *Bark* smooth, light grey with a white bloom at first, aging rough and dark grey to grey–brown or blackish on main stems, the upper branches similar or smooth and pruinose. *New shoots* light purple. *Branchlets* thick and angled by narrowly winged ribs on young plants, becoming terete, often more slender and ribs not winged with age, glabrous, pruinose. *Phyllodes* very variable (see discussion below), positioned on obvious stem projections, outer edge often continuous with the branchlet rib, glabrous, (6–)8–12 cm long; *juvenile phyllodes* elliptic to obovate, generally 3–6(–8) cm wide with l:w = 1.5–2(–3), straight, coriaceous, ± undulate, glaucous, pruinose, rounded-obtuse; *adult phyllodes* narrowly elliptic to oblanceolate, generally 1–3 cm wide with l:w = 4–8, straight to shallowly recurved, grey–green to sub-glaucous, sub-acute to acuminate; *base* oblique; *midrib* rather prominent, central or slightly excentric; finely penninerved, the smallest veins anastomosing. *Gland* not prominent, situated on upper margin of phyllode 2–6 cm above pulvinus. *Inflorescences* racemose (occasionally some paniculate), racemes single within axils of phyllodes towards ends of branchlets; *raceme axes* (1.5–)2.5–8(–15) cm long with (6–)9–30(–42) heads, glabrous or sparsely to moderately appressed light golden hairy, indumentum densest prior to anthesis; *peduncles* (3–)4–6(–8) mm long, indumentum as on raceme axes; *heads* obloid to globular, golden, showy, densely (33–)40–60(–75)-flowered, 8–12 mm diam. (fresh), 6–9 mm diam. (dry). *Bracteoles* spatulate to sub-peltate, 1–1.5 mm long, claws linear, laminae sub-circular to depressed-trullate, brown and fimbriolate with yellow hairs. *Flowers* 5-merous, 2 mm long; *calyx* $\frac{3}{4}$ length of corolla, gamosepalous, very shallowly dissected into inflexed, ± rounded lobes which are yellow-hairy and slightly thickened abaxially, calyx tube red–brown (dry) and glabrous; *petals* glabrous to sparsely appressed-hairy (hairs yellow), very obscurely 1-nerved. *Pods* narrowly oblong, straight-edged to ± shallowly constricted

between seeds, occasional deep constrictions occur on some pods, flat but gently rounded over seeds, to 11(–14) cm long but often shorter, (7–)8–10(–12) mm wide, firmly chartaceous to thinly coriaceous, straight to shallowly curved, dehiscing unilaterally, glabrous, purple–brown, variably pruinose, often persisting (in clumps) on plants for some time following dehiscence. *Seeds* longitudinal to oblique in pods, oblong to elliptic or circular, 4–6 mm long, 3–5 mm wide, flattened (2 mm thick), slightly shiny, \pm smooth, very dark brown to black; *pleurogram* obscure, continuous; *areole* 2–3 \times 1–1.5 mm; *funicle* cream, light brown or dark red–brown (when fresh: colour probably age-dependent), dark red–brown when dry, $\frac{3}{4}$ to wholly encircling seed in single or double fold; *aril* clavate, creamy white. (Figure 1)

Selected specimens examined. WESTERN AUSTRALIA: NE of Dandaragan [precise localities withheld], *R. Cumming* 3559a & b (MEL, PERTH); *C.P. Elliott* 1–9 (all PERTH); *S.J. Greens.n.*, March 1917 (PERTH); *S.D. Hopper* 2378 (PERTH); *S. van Leeuwen* 269 (PERTH); *B.R. Maslin* 5360 (PERTH), 6024 (PERTH), 6116 (MEL, PERTH), 6117–6119 (all PERTH), 6021–6025 (all PERTH); *A. Popplewell.s.n., s. dat.* (AD, CANB, NSW, NY, PERTH 00720577) and *s.n.*, 20 Nov. 1981 (PERTH).

Distribution and habitat. Known from only a single population NE of Dandaragan, W.A., where it forms a dense stand on slopes and at base of a small laterite breakaway. Grows on brown loamy clay or gravelly loam in Eucalyptus low woodland with little understorey (probably due to former grazing of the site); *Dryandra sessilis* var. *flabellifolia* A.S. George is a common associate. The species does not extend to sandy soils which occur adjacent to the western edge of the population. There are about 111,000 plants in the population but many of these undoubtedly represent ramets of clonal individuals; the frequency of plants varies according to landform, with the highest density (1.22 plants m^{–2}) occurring on the colluvial slopes of the breakaway (Elliott *et al.* 2002).

Flowering and fruiting periods. The main flowering flush is in May and June. Flowering may commence on plants as small as 1 m tall (but these may be ramets of clonal individuals). Pods with mature seeds have been collected in late November and early December.

Conservation status. Conservation Codes for Western Australian Flora: Rare. In 1989 *Acacia splendens* [under the name ‘*Acacia* sp. Dandaragan (*S. van Leeuwen* 269)’] was formally gazetted as Declared Rare Flora (and ranked as Endangered) under the Western Australian Wildlife Conservation Act 1950 and is currently also listed as Endangered under Commonwealth legislation, namely, the Environment Protection and Biodiversity Conservation Act 1999.

Etymology. The specific epithet is derived from the Latin ‘*splendeo*’ (shine) in allusion to the bright golden-coloured flower heads that are produced in great profusion in May and June.

Affinities. The new species is most closely related to *A. microbotrya* and *A. daphnifolia* on account of its 1-nerved phyllodes, globular to obloid heads arranged in racemes, seeds encircled by a dark-coloured funicle and more particularly by its gamosepalous calyx, yellow-hairy raceme axes, peduncles, flowers and bracteoles and its overall flower, bracteole and seed morphology. Like its two relatives *A. splendens* may spread by root suckers and it flowers earlier in the season than many other Wattles in southwest Western Australia. *Acacia splendens* is readily distinguished from both *A. microbotrya* and *A. daphnifolia* by its pruinose branchlets and pods (the trunks are also smooth and white-pruinose, at least on young plants), more numerous flowers per head, broader phyllodes (especially the juvenile ones) and narrowly oblong pods. It is further distinguished from *A. microbotrya* by its golden-coloured heads and from *A. daphnifolia* by its smaller seeds. Details of *A. microbotrya* and *A. daphnifolia* are given in Maslin (in prep.). Other differences between these taxa are given in Elliott *et al.* (2002; note that in this work *A. splendens* is referred to as ‘*A. sp. Dandaragan*’ and *A. daphnifolia* as *A. microbotrya* var. *borealis*).

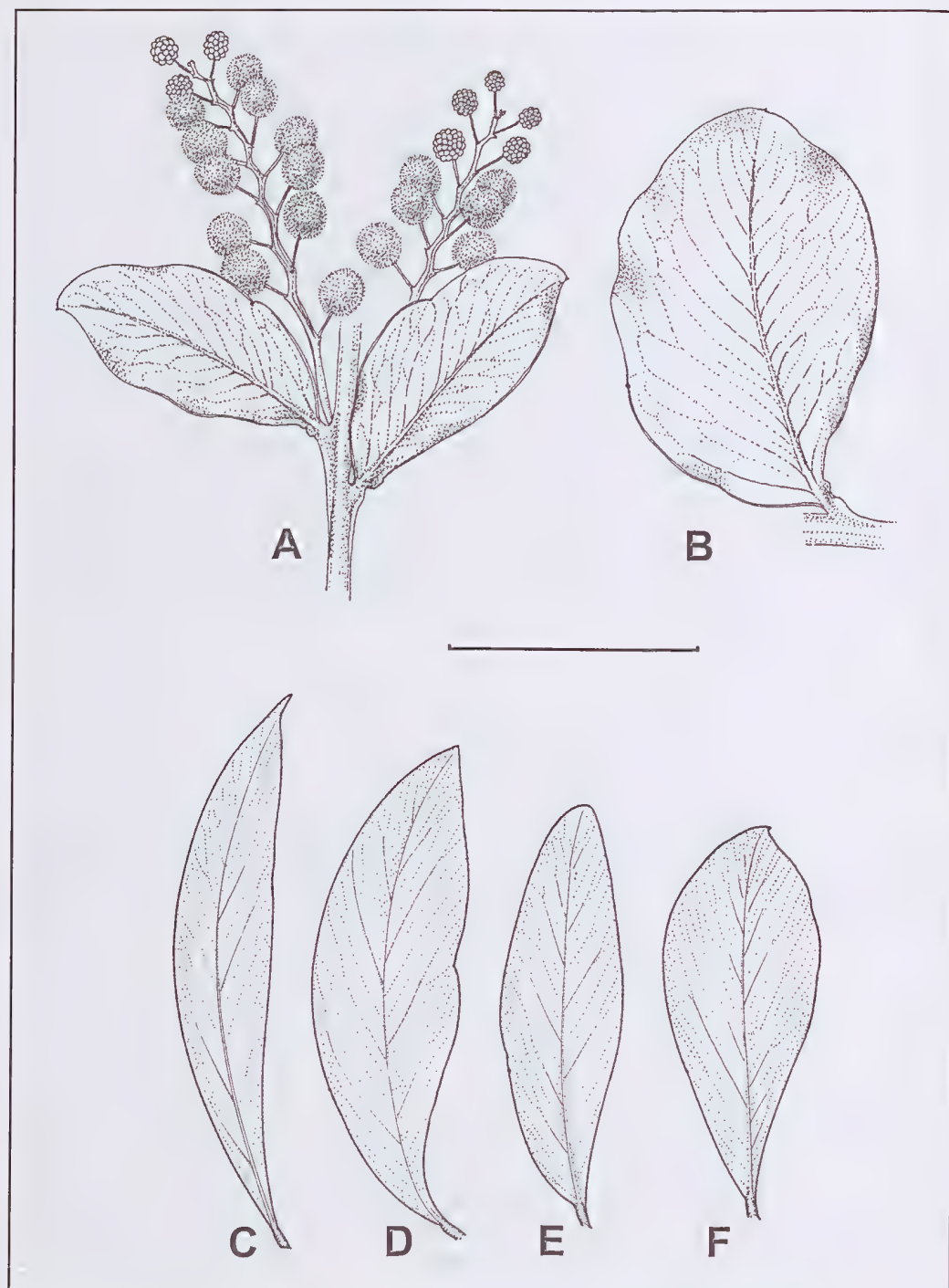


Figure 1. *Acacia splendens*. A – flowering branch (showing adolescent phyllodes), B to F – range of phyllodes showing variation at different growth stages (B – juvenile, C – adult, D to F – adolescent). A from *A. Popplewell s.n.* (PERTH 00720577), B from *B.R. Maslin* 6116, C from *B.R. Maslin* 5360, D from *C.P. Elliott* 4, E from *B.R. Maslin* 6024, F from *S.D. Hopper* 2378. Pods and seeds of the species are illustrated in *Maslin* (2001a and 2001b). Scale bar = 5cm.

Characteristic features. *Acacia splendens* is recognized by its glabrous, pruinose branchlets, 1-nerved phyllodes which are large, glaucous and \pm undulate when young; many-flowered, golden heads that are arranged in showy racemes; narrowly oblong, variably pruinose pods and relatively small seeds that are encircled by a normally red-brown funicle. Perhaps the most striking feature of this new species is its great range of variation in phyllode shape and size with juvenile phyllodes significantly different in form from adult ones (see *Variation* below).

Variation. Phyllodes vary considerably in shape, size and curvature, and in the shape of their apices. This variation appears to be related to the biological maturity of the foliage which seems to vary independently of the actual age of the plants. For the purpose of this discussion the phyllodes are classed as juvenile, adolescent and adult (this same terminology has been used to describe phyllodes of the *A. aneura* group, fide Miller *et al.* 2002). The juvenile phyllodes (Figure 1B) are elliptic to obovate, very broad (generally 3–6(–8) cm wide with $l:w = 1.5\text{--}3$), \pm undulate, coriaceous, glaucous, pruinose, straight and rounded-obtuse. Mature adult phyllodes are very different (Figure 1C), being narrowly elliptic to oblanceolate, narrower and more elongate (generally 1–3 cm wide with $l:w = 4\text{--}8$), not undulate, straight to shallowly recurved, more thinly textured, straight to shallowly recurved and acute to acuminate. These different phyllode forms, and many intermediates between them (i.e. adolescent phyllodes, see Figure 1A & D–F) occur on biologically mature plants (i.e. plants that produce flowers and fruits). It is not known what factors control the change in phyllode form, however, it appears not to be strictly correlated with the age of the plants. For example, shrubs as tall as 4 m with clearly mature (rough) bark may have only juvenile phyllodes, while seemingly young plants just 2 m tall with smooth stems may have adolescent phyllodes. Most biologically mature plants in the population have either juvenile or adolescent phyllodes and these are presumably neotenus; plants with the adult phyllode form are not common. Additionally, it is not uncommon to observe branches with adult phyllodes at the base giving way to adolescent or juvenile ‘reversion’ foliage higher up. Neoteny, or presumed neoteny, has been reported in species of the Mulga group (i.e. *A. aneura* and its allies, see Miller *et al.* 2002); it is also present in *A. daphnifolia*, a close relative of *A. splendens* (see below).

Biology. Judging from the performance of plants in cultivation in Perth, *A. splendens* has a fast growth rate and is relatively short-lived. For example, plants at Kings Park and Botanic Garden attained a height of about 10 m with a basal trunk diameter of 26 cm in 13 years while the most vigorous plants grown at the Western Australian Herbarium attained 5 m in height with a basal trunk diameters of 15 cm in about 5 years. Interestingly, in both these cases the bark on the main trunks was smooth and white-pruinose; the distinctive rough dark-coloured bark which is found on most plants in the wild presumably develops on older plants (although it is not known to what extent, if any, the growing conditions under cultivation influences bark development).

In nature plant recruitment occurs from both seeds (which are produced in great profusion) and by suckers (the level of clonality is unknown but it appears to be reasonably considerable). Elliott *et al.* (2002) showed that the size class structure of plants in the Dandaragan population shows a reverse J curve with a large number of small plants and a few large ones. Plants less than 30 cm tall were examined and 98.8% were found to be clonal ramets. The remaining 1.2% of plants were seedlings, indicating recruitment from a soil seed bank (20 ± 11.3 seeds m^{-2}) in the population. Germination physiology of *A. splendens* showed the seed to have a reasonably high level of non-dormancy, with non-scarified seeds germinating at a rate of $61.2\% \pm 6.41$ and scarified seeds at $94\% \pm 1.86$. The effect of thermal shock on germination for *A. splendens* was similar to the non-scarified seeds, indicating that thermal shock does not simulate scarification. Nevertheless, the seed was resistant to thermal shock up to 80°C, but germination declined at higher temperatures.

Further information on the ecology, population structure and life history of *A. splendens* is provided by Elliott *et al.* (2002).

Acknowledgements

We wish to express our appreciation of the efforts of the late Mr Alf Popplewell who brought the species to the attention of the first author in 1981. Mr Popplewell, who lived on the property 'Attunga' at Dandaragan, made some fine flowering and fruiting collections of this plant and through his explorations in the Dandaragan region was able to determine that it was likely to have a very restricted natural occurrence. It is unfortunate that the species was not able to be formally described prior to Mr Popplewell's death in November 2002. We also thank Paul Wilson for preparing the Latin description and Margaret Pieroni and Martin Thompson for illustrations Figure 1A–B and Figure 1C–F respectively. We also wish to thank Dr Colin Yates and Dr Philip Ladd who were responsible for supervising the ecological and allozyme research conducted on the species in 2000 by the second author as part of a Conservation Biology Honours degree.

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Formal recognition of *Eucalyptus platydisca* (Myrtaceae), an arid-zone monocalypt from south-western Australia

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Abstract

Nicoll, D. & Brooker, M.I.H. Formal recognition of *Eucalyptus platydisca* (Myrtaceae), an arid-zone monocalypt from south-western Australia. *Nuytsia* 16(1): 87–94 (2006). The new species *Eucalyptus platydisca* is formally described, the species having been long recognised as a distinct taxon under the manuscript name *E. platydisca* and under various phrase names including the common name Jimberlana mallee. The new species is known from just two populations near Norseman in Western Australia and is included in Western Australia's Schedule of Declared Rare (Endangered) Flora. The new species is closely related to, but readily distinguishable from, *E. diversifolia*, differing in the narrower juvenile leaves, the consistently 7-flowered inflorescences, the longer, conical to horn-shaped operculum, the broader fruits with a consistently broad disc and the granite hill habitat. *Eucalyptus platydisca* is probably a relictual species and occurs in the lowest rainfall environment of any monocalypt (*Eucalyptus* subgenus *Eucalyptus*). The new species is part of *E.* subser. *Neuropterae*, and a key for the subseries is presented.

Introduction

The monocalypts (*Eucalyptus* subg. *Eucalyptus*) are a predominantly eastern Australian group of mostly trees from relatively mesic environments. The monocalypts are characterised within the eucalypts by their combination of reniform cotyledons, lack of pith glands, simple and axillary inflorescences, asepalous flower buds, single opercula and ovules in 2 (rarely 4 in a few species) vertical rows.

Within the monocalypts, *Eucalyptus* sect. *Longistylus* and the monotypic *E.* sect. *Pedaria* (*E. brevistylis* Brooker) are the only taxa to occur west of Kangaroo Island in Australia, the former section also including most of the mallee species within the monocalypts. All species of *E.* sect. *Longistylus* except *E. diversifolia* are endemic to the south-western Australia – *E. diversifolia* spans the south coast of the continent from near Toolinna in Western Australia eastwards to Cape Nelson in Victoria.

The new species described in this paper is part of *Eucalyptus* ser. *Diversiformae* Blakely subser. *Neuropterae* (Maiden) Brooker distinguished by its erect-held, seven or more flowered axillary inflorescences, smooth fruit and brown seeds. We recognise 24 terminal taxa within *E.* ser. *Diversiformae*, of which half have been described since 1972 and six of which are included in Western Australia's Schedule of Declared Rare (Endangered) Flora (*E. coronata*, *E. dolorosa*, *E. johnsoniana*, *E. lateritica*, *E. platydisca* and *E. suberea*). The subseries has a number of apparently relictual taxa restricted to

isolated hills and ranges such as the lateritic hills of Mt Lesueur and surrounds (four endemics – *E. johnsoniana*, *E. lateritica*, *E. pendens* and *E. suberea*), the Stirling Range (two endemics – *E. erectifolia* and *E. ligulata* subsp. *stirlingica*), the hills of Fitzgerald River National Park (two endemics – *E. coronata* and *E. sepulchralis*) and the granite domes of Mt Le Grand, Cape Arid and the Recherche Archipelago (two endemics – *E. aquilina* and *E. ligulata* subsp. *ligulata*).

Taxonomy

Eucalyptus subser. **Neuropterae** (Maiden) Brooker. *Aust. Syst. Bot.* 13: 131 (2000).

Type: *Eucalyptus todtiana* F. Muell.

Eucalyptus subser. *Neuropterae* is a subseries of eight taxa distributed mainly in coastal and subcoastal southern Western Australia and extending eastwards along coastal areas through South Australia to Cape Nelson in western Victoria.

Eucalyptus diversifolia and *E. platydisca* can be distinguished within *E. subser. Neuropterae* by the smaller and non-flanged or barely flanged seeds (Figure 1). The smaller seeds in these two species compared to the remainder of *E. subser. Neuropterae* are notably independent of fruit size, as several species in the subseries (such as *E. erectifolia* Brooker & Hopper and *E. pachyloma* Benth.) have comparable fruit size to *E. platydisca* and larger-fruited variants of *E. diversifolia*, but have significantly larger seeds.

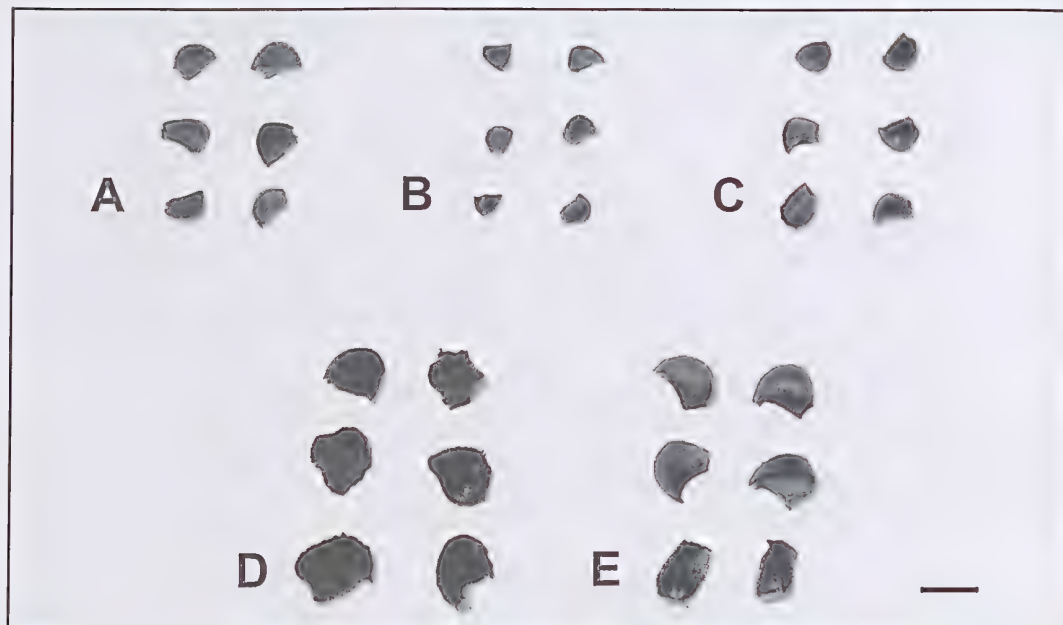


Figure 1. Seeds. A – *E. platydisca* (D. Nicolle 133, north side of Mount Norcott, north-east of Norseman, WA); B – *E. diversifolia* subsp. *hesperia* (D. Nicolle 1811, east of Border Village, Great Australian Bight, SA); C – *E. diversifolia* subsp. *diversifolia* (D. Nicolle 1991, Cape Nelson, south of Portland, Vic.); D – *E. johnsoniana* (D. Nicolle 3547 & M. French, south of Eneabba, WA); E – *E. pachyloma* (D. Nicolle 224, south-east of Stirling Range, WA). Scale bar = 3 mm.

Key to taxa of *Eucalyptus* subser. *Neuropterae*

1. Bark rough and fibrous over most of stems
 2. Adult leaves without visible oil glands ***E. todtiana***
 2. Adult leaves with numerous visible oil glands ***E. lateritica***
1. Bark smooth throughout or mostly smooth
 3. Fruit globose, with non-prominent and descending disc ***E. johnsoniana***
 3. Fruits obconical to cupular, often with prominent disc
 4. Opercula >1.5 times as long as hypanthia, conical to beaked ***E. platydisca***
 4. Opercula <1.5 times as long as hypanthia, hemispherical to conical
 5. Seeds distinctly flanged, >3 mm long; south-west WA only
 6. Fruits cupular, disc level to descending or annular ***E. erectifolia***
 6. Fruits obconical, disc prominent, ascending ***E. pachyloma***
 5. Seeds not or barely flanged, <3 mm long; eastwards from Nullarbor cliffs
 7. Fruits to 8 mm long, to 12 mm wide, disc level ***E. diversifolia* subsp. *hesperia***
 7. Fruits >8 mm long, >10 mm wide, disc level to ascending ***E. diversifolia* subsp. *diversifolia***

Eucalyptus platydisca Nicolle & Brooker ex L.A.S. Johnson & K. Hill, *sp. nov.*

Typus: Jimberlana Hill, NW of Norseman, Western Australia, 8 April 1983, *M.I.H. Brooker* 8064 (*holo*: CANB00431938; *iso*: MEL 1614358, PERTH01046225).

A *E. diversifolia* foliis juvenilibus angustioribus, inflorescentiis constanter 7-floribus, operculis conicis vel cornutis longioribus, fructibus disco constanter latiore, et habitatione non calcarea differt.

Differs from *E. diversifolia* in the narrower juvenile leaves, the consistently 7-flowered inflorescences, the longer, conical to horn-shaped operculum, the broader fruits with a consistently broad disc and the granite hill habitat.

Mallee 2–5 m tall, lignotuber present. *Bark* smooth throughout, decorticating in strips and short ribbons, grey over cream. *Juvenile leaves* sessile, opposite for *c.* 10 pairs; lamina discolorous, dull, blue–green, lanceolate, 60–80 mm long × 18–30 mm wide. Branchlets non-pruinose, pith glands absent. *Adult leaves* petiolate, disjunct, held erect; lamina concolorous, dull, slightly blue–green, narrow-lanceolate to lanceolate, often falcate, 70–115 mm long × 8–18 mm wide; vein reticulation moderate; oil glands scattered, intersectional and island. *Inflorescences* axillary, unbranched, held erect, 7-flowered; peduncles terete to angular, 6–13 mm long; pedicels terete to angular, 2–6 mm long. Flower buds pedicellate, diamond-shaped, 10–17 mm long × 6–10 mm wide, no median scar; opercula long-conical to beaked, usually slightly constricted at halfway point, 1.5–2 times as long as hypanthia. *Flowers* white; stamens variously-flexed, all fertile; anthers versatile, oblong, opening by longitudinal slits. *Fruits* very shortly pedicellate, broadly obconical to cupular to slightly campanulate, 8–14 mm long × 12–16.5 mm wide; disc level to slightly ascending or somewhat annular, broad, 2–5 mm wide; valves 4 or 5, at rim level or slightly exserted. *Seeds* brown, 2–3 mm long, with an indistinct reticulum. (Figure 2)

Selected specimens examined: WESTERN AUSTRALIA: Stony hill 3 miles E of Norseman, 2 Feb. 1935, *C.A. Gardner* s.n. (CANB, PERTH); Granite hills, 5 miles E of Norseman, 8 Nov. 1953, *C.A. Gardner* 11178

(CANB, MEL); 6 miles [9.5 km] E of Norseman on Eyre Hwy, 7 Nov. 1962, *M.E. Phillips s.n.* (CANB); 3.5 miles E of Norseman, 23 Mar. 1968, *G.M. Chippendale* 383, 384 (AD, CANB, PERTH); 10 miles E of Norseman, Apr. 1969, *B.A. Rockel s.n.* (CANB); 4 miles NE of Norseman, 14 Feb. 1970, *M.I.H. Brooker* 2487 (CANB); 0.2 miles (R) of Eyre Hwy, 4.2 miles E of Norseman, at foot of Mt Jembaluna [*sic*], 13 Nov. 1970, *J.P. Baker* 55 (CANB); *C.* 4 miles NE Norseman, 26 Apr. 1972, *M.I.H. Brooker* 3644 (CANB); Jimberlana Hill, 28 July 1978, *C.D. Boomsma* 355 (AD, NSW); Coolgardie District: Jimberlana Hill, 7 km NNE of Norseman, 1 Feb. 1979, *M.D. Crisp* 5636, 5637 (CANB, PERTH); Jimberlana Hill, 28 Apr. 1982, *M.I.H. Brooker* 7488 (CANB, PERTH); Jimberlana Hill, 7.5 km NE of Norseman, 200 m S of Eyre Hwy, 8 Apr. 1983, *S.D. Hopper* 2736 (CANB, PERTH); Jimberlana Hill, 10 July 1983, *S.D. Hopper* 2936 (PERTH); North side of Mount Norcott, NE of Norseman, 32°07'06"S, 122°00'31"E, 6 Dec. 1992, *D. Nicolle* 133 (AD); Summit of Jimberlana Hill, 5.9 km NE of Norseman, 16 Apr. 1995, *T.R. Lally & B.J. Lepschi* 541 (AD, CANB, PERTH); Jimbylanica [Jimberlana] Hill on Eyre Hwy, 15 Aug. 1995, *R.J. Cranfield* 10007 (CANB, PERTH); Mt Norcott, 4.7 km S of the Eyre Hwy; track turnoff is 29.5 km E of the Norseman Post Office along the Eyre Hwy, 30 Apr. 2000, *B. Archer* 1573 (CANB, MEL, PERTH); Jimberlana Hill, 20 Oct. 2001, *M.D. Crisp* 9401 (CANB).

Distribution and habitat: Known from two granite hills in the Dundas Hills north-east of Norseman in Western Australia, viz: Jimberlana Hill and Mount Norcott, where the species grows in loam between granite boulders and scree (Figure 3). The species is the dominant plant on the slopes of both of these hills, forming a very open mallee shrubland with a *Triodia*-dominated understorey. At the lower footslopes of Jimberlana Hill, *E. platydisca* may be associated with *E. longissima* Nicolle and/or *E. planipes* L.A.S. Johnson & K.D. Hill.

Conservation status: Approximately 200 individuals occur on Jimberlana Hill (Kelly *et al.* 1995), which is accessible by its proximity adjacent to the Eyre Highway and close to the township of Norseman. The population on the relatively inaccessible Mt Norcott appears to be larger, although an estimate of individual numbers has not been attempted. The species has been allocated the conservation code 2V (vulnerable) by Briggs & Leigh (1996). Conservation Codes for Western Australian Flora: Rare.

It is possible, but unlikely, that further populations remain undiscovered, as both the new species and its habitat are distinctive and a past recent search for the new species on hills of similar elevation to the north of Mt Norcott (Nicolle and French, July 2001) was unsuccessful.

Etymology: The specific name is derived from the Greek *platys* (broad; level) and *discus* (disc; a circular plate), referring to the broad and prominent fruit disc.

Notes: This species has long been recognized as a distinct taxon, although without formal status, both under the manuscript name *E. platydisca* (Briggs & Leigh 1996) and under various phrase names, including '*E. sp. C*' (Brooker & Kleinig 1990), '*E. sp. C aff. diversifolia*' (Kelly *et al.* 1995) and '*E. sp. Norseman (S.D. Hopper 2936)*' (Western Australian Herbarium 2006).

Eucalyptus platydisca is probably a relictual species due to the withdrawal of the moisture-loving subgenus *Eucalyptus* to the wetter south and west. Its very restricted distribution is disjunct from all other monocalypt taxa due to its habitat in an arid environment, where effective rainfall is increased by runoff due to rock cover, slope and crevices. The species occurs in the lowest rainfall environment of any monocalypt. The species is morphologically closest to *E. diversifolia*, particularly subsp. *hesperia*, which occurs at its closest over 250 km to the east above the Baxter Cliffs on the edge of the Nullarbor. *Eucalyptus diversifolia* subsp. *hesperia* is somewhat intermediate in morphology between *E. platydisca* and typical *E. diversifolia* (and occurs in between geographically) and shares with the new species its

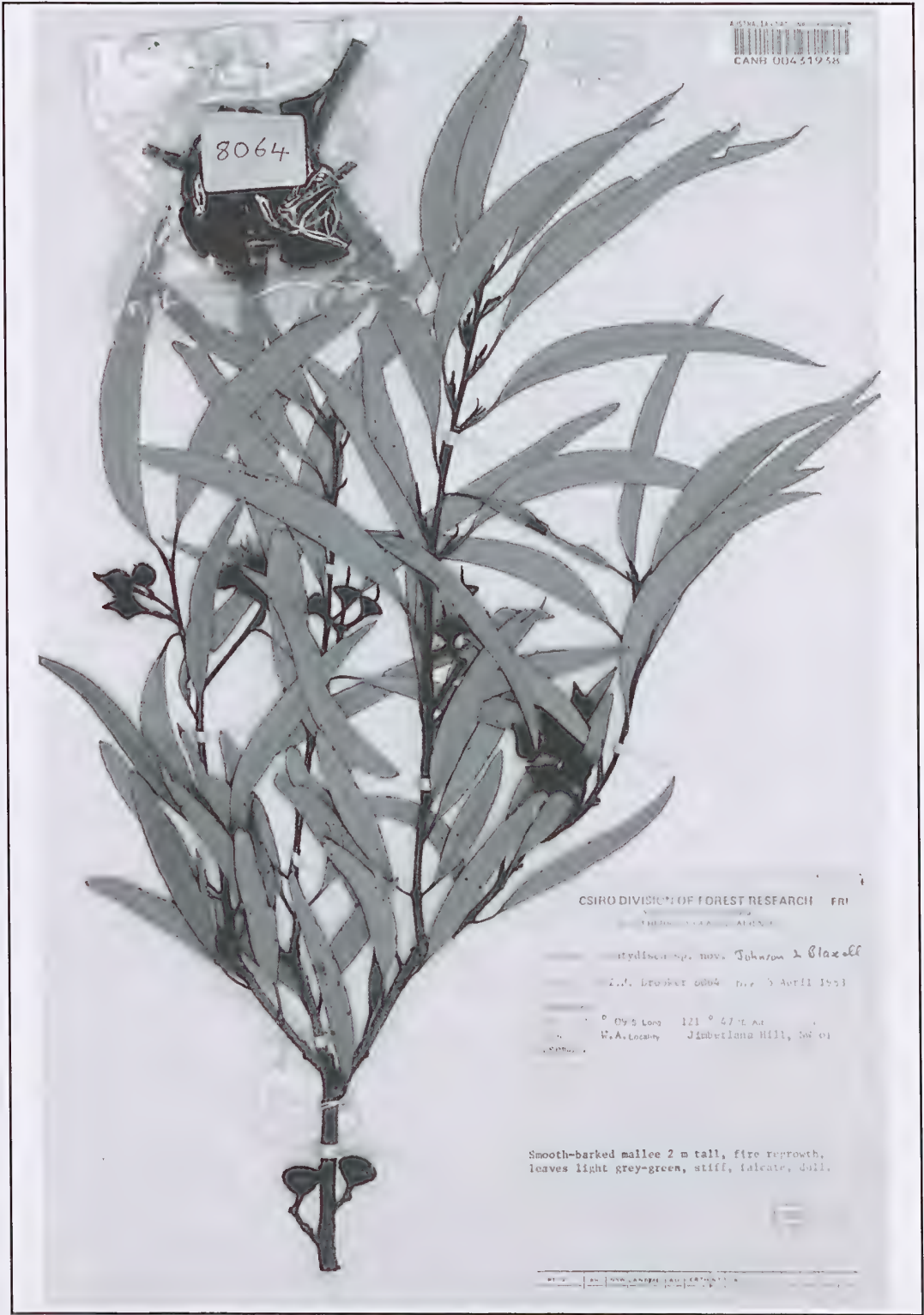


Figure 2. Holotype of *Eucalyptus platydisca* (M.I.H. Brooker 8064 – CANB 00431938).

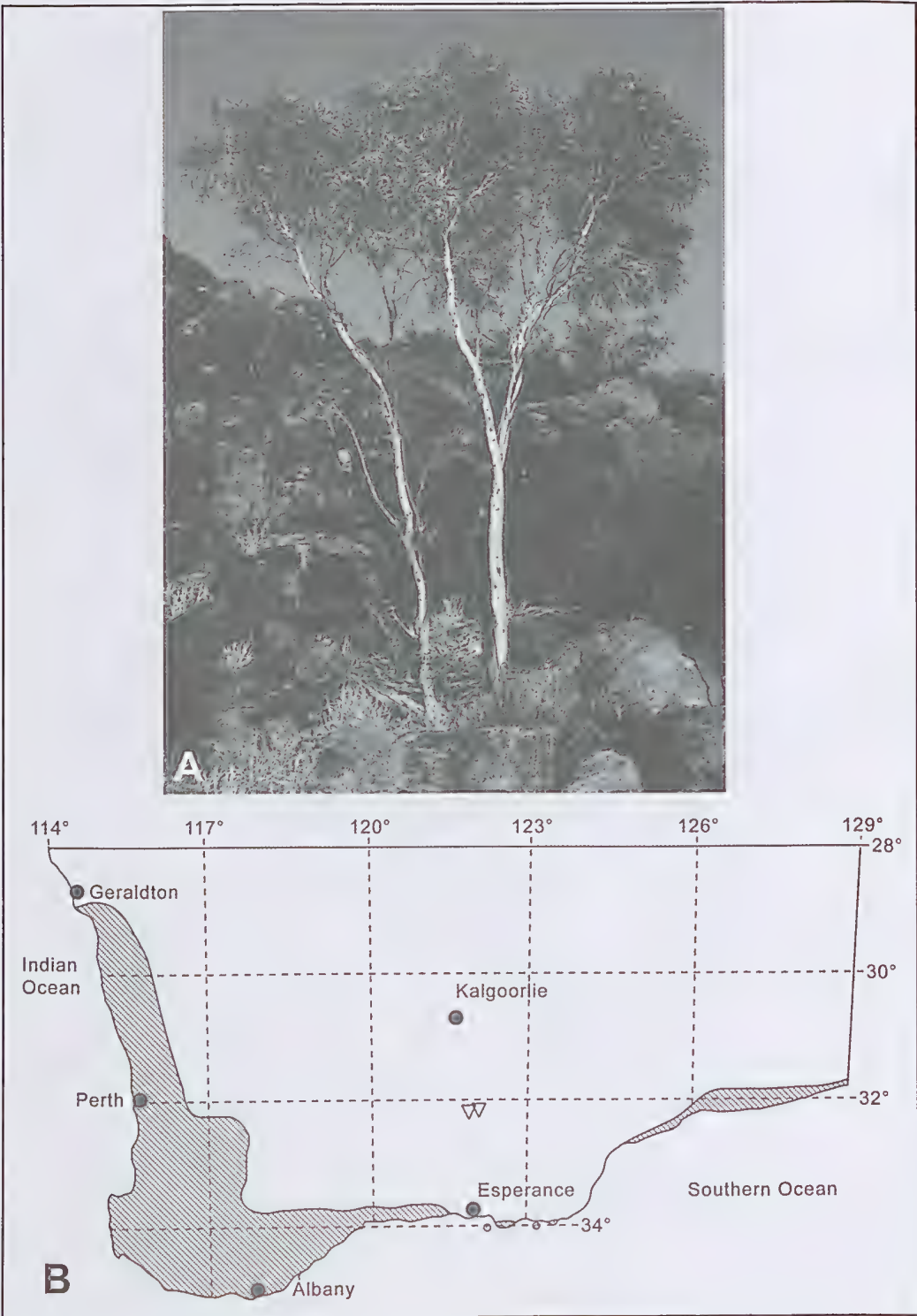


Figure 3. A – *Eucalyptus platydisca* at Jimberlana Hill, WA; B – map of Western Australia below 28°S, showing the distribution of *E. platydisca* (▽) and all other Western Australian monocalypts (shaded areas).

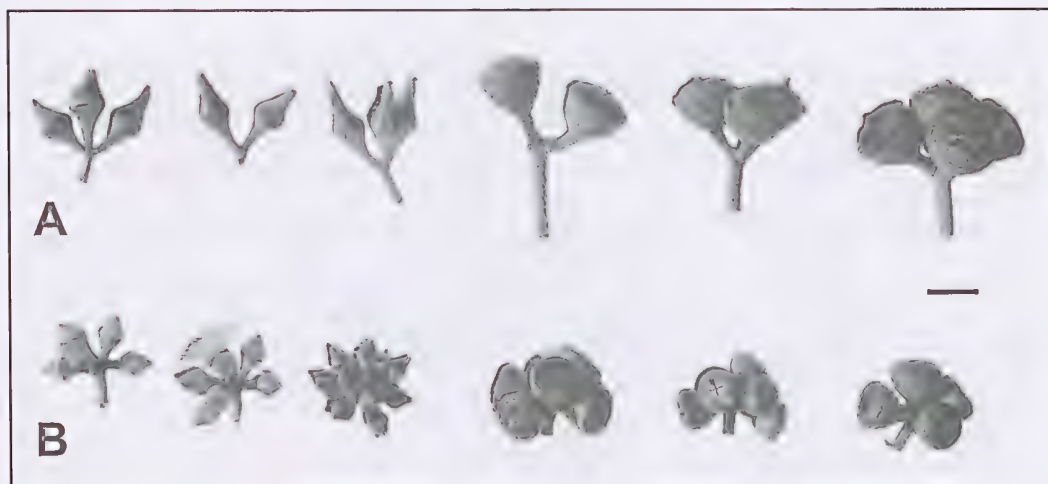


Figure 4. Mature flower buds and year old fruits. A – *E. platydisca* (top row; F1 of *D. Nicolle* 133, north side of Mount Norcott, north-east of Norseman, WA); B – *E. diversifolia* subsp. *hesperia* (bottom row; F1 of *D. Nicolle* 1811, east of Border Village, Great Australian Bight, SA). Scale bar = 10 mm.

narrower juvenile leaves, pointier opercula and a more consistently level fruit disc (none of which are as pronounced as in the new species) compared to typical *E. diversifolia*.

Eucalyptus platydisca differs from *E. diversifolia* subsp. *hesperia* in the narrower juvenile leaves (narrowly ovate in *E. diversifolia* subsp. *hesperia*), the consistently 7-flowered inflorescences (to 15-flowered in *E. diversifolia* subsp. *hesperia*), the longer buds with a long-conical to beaked operculum (buds to 11 mm long and with a conical operculum and generally equal in length to hypanthium in *E. diversifolia* subsp. *hesperia*) and the broader fruits (to 10 mm wide in *E. diversifolia* subsp. *hesperia*) (Figure 4).

Eucalyptus platydisca differs from *E. diversifolia* subsp. *diversifolia* in the narrower juvenile leaves (ovate to elliptical in *E. diversifolia* subsp. *diversifolia*), the consistently 7-flowered inflorescences (to 15-flowered in *E. diversifolia* subsp. *diversifolia*), the buds with a long-conical to beaked operculum (buds with a rounded to conical operculum and generally equal in length to hypanthium in *E. diversifolia* subsp. *diversifolia*) and the generally broader fruits (to 14 mm wide in *E. diversifolia* subsp. *diversifolia*).

The habitat of *E. platydisca* also differs from *E. diversifolia*, being more arid and occurring on granite hills (mainly coastal and on aeolian soils overlying limestone in *E. diversifolia*).

Acknowledgements

The authors thank Bob Nicolle for accompaniment and assistance on a field trip to Mt Norcott in 1992 and Malcolm French for accompaniment and assistance on a field trip to search for further populations of the new species in 2001. We thank John Connors for photographing the type specimen in CANB.

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A review of the tuberous *Calandrinia* species (section *Tuberosae*), including three new species for Western Australia

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Abstract

Obbens, F. J. A review of the tuberous *Calandrinia* species (section *Tuberosae*), including three new species for Western Australia. *Nuytsia* 16(1): 95–115 (2006). Background on the current systematic status of Australian *Calandrinia* is explained. Three new species of section *Tuberosae* von Poellnitz are described and illustrated: *Calandrinia crispisepala* Obbens, *C. kalanniensis* Obbens and *C. translucens* Obbens. A key to section *Tuberosae* is provided. Additional descriptive material for the previously named species is provided along with notes that explain the important differences and similarities between the six species now belonging to this section.

Introduction

By far the majority of the Australian species of *Calandrinia* are annuals while several are ‘short-lived’ perennials. In addition there are some species that are perennials with tuberous root systems. All of these tuberous species are endemic to Western Australia and comprise section *Tuberosae* of von Poellnitz (1934) as described in his revision of the Australian species of *Calandrinia*. He recorded 8 sections, 6 being endemic to Australia (i.e. sects. *Partitae*, *Basales*, *Apicales*, *Tuberosae*, *Uniflorae*, and *Pseudodianthoideae* – von Poellnitz 1934) while the other 2 (i.e. sects. *Axillares* and *Compressae* – Reiche 1897) were of introduced species that originated in America from where the genus was first recognized (Kunth 1823). Karl von Poellnitz described section *Tuberosae* as containing perennial glabrous plants with root systems that consisted of a slender rhizome attached to a distinct tuber, or with the root entirely tuberous, with a one or many flowered inflorescence, the capsules valvate and with the endocarp firmly joined to the exocarp. In conclusion, he stated that all species in the section had basal leaves only. To this one should also add that species in section *Tuberosae* have flowers that are 5-merous and have 3 stigmata that are either united onto a style or are free to the base. However, Carolin (1993) stated that this section had “stigmata 4, sometimes connate”, which I assume to have been a typographical error.

Karl von Poellnitz’s use of the word ‘rhizome’ in his section description is strictly speaking erroneous as a rhizome is considered to be a modified stem. The ‘rhizome’ appears to be a true root attached to a tuber beneath. I have used the term ‘root’ throughout the text to describe this structure so as not to perpetuate this error.

Syeda (1980) undertook the next significant research with her M.Sc. thesis, a treatment of the Australian *Calandrinias*. She suggested that there were only 3 recognizable endemic sections in Australia by merging *Uniflorae* into *Basales* (essentially a 4 carpel group) and merging *Apicales* into *Pseudodianthoideae* (a 3 carpel group) while maintaining *Tuberosae* (another 3 carpel group). Section *Partitae* was excluded as being conspecific with *Anacampseros australiana*. A subsequent cladistic analysis of Australian *Calandrinia* by Syeda and Ashton (1989) generally reinforced her earlier work that there are only 3 sections.

However, there are some errors within Syeda's original work that stem from incorrect identification of species, a commonly occurring problem. This M.Sc. research had Type specimens available for most, but not for all the species studied. For each species, the treatment also cited a selection of other specimens and some of these were used for the seed studies. There are no Types cited within the 12 specimens examined for *Calandrinia lehmannii* and the seed SEM and distribution shown for that species as displayed in Figure 3:19 of her thesis is incorrect. The seed SEM is actually that for *Calandrinia crispisepala* (see description below) and at least a third of the specimens she cited from the Eremaean Botanical Province are not *C. lehmannii* as this is essentially a species of the Avon Wheatbelt region and the adjoining eastern goldfields areas.

A worldwide review of the Portulacaceae by Carolin (1987) included cladistic analyses of 11 *Calandrinia* sections three being endemic to Australia (i.e. accepting Syeda's sects. *Basales*, *Tuberosae* and *Pseudodianthoideae*). The cladogram resulting from Carolin's study indicated five *Calandrinia* segregates that he suggested should each have generic status. Furthermore, the study revealed the Australian *Calandrinia* species (i.e. one of the five segregates) to be clearly different from their American counterparts. For the Australian segregate he used the generic name *Rumicastrum* Ulbrich as this appeared to be an appropriate available name, but he did not publish new combinations. Unfortunately, Ulbrich (1934) incorrectly placed *Rumicastrum* within the family Chenopodiaceae although it clearly is a member of the Portulacaceae (Wilson 1984), but its affinities within the family are uncertain. Hershkovitz (1998) has published the name *Parakeelya* for the Australian *Calandrinia* species on the basis of his belief that *Rumicastrum* belongs in the Chenopodiaceae. *Parakeelya* has not been generally accepted in Australia due to the aforementioned disagreement over the family placement of *Rumicastrum* and also whether or not *Rumicastrum* is congeneric with the other Australian species of *Calandrinia*.

Syeda and Carolin (1989) analyzed seed type and surface patterning within these *Calandrinia* segregates and this resulted in a classification table that had significant congruence to Carolin's previous research. It should suffice to acknowledge that systematic work on *Calandrinia* is still required, but all research so far has suggested that the integrity of section *Tuberosae* is not in question. As Syeda and Carolin (1989) state, "the only section which is more or less consistent is sect. *Tuberosae* with a straighter embryo, less perisperm and a tuberculate or verrucate surface". Most significant, however, is that this research has reinforced the importance of seed characters in a broad classification within the genus as well as at the species level.

In past years, there has been some difficulty in identifying the members of section *Tuberosae* to species level. Part of the problem is caused by large variations that commonly occur within species of this genus. For the most part though, this situation has arisen because of inadequate species descriptions, the confusing presence of hitherto unrecognized tuberous species and a lack of knowledge about crucial characters (e.g. seeds, tubers, flowers, stems, bracts etc.). Apart from describing the three

new species, this paper seeks to address these other problems by providing additional descriptions for the existing taxa (i.e. *Calandrinia lehmannii*, *C. primuliflora* and *C. schistorhiza*) and by outlining taxonomically important features that serve to distinguish the species within section *Tuberosae*.

Methods

For each of the new species described, measurements were taken from either dry pressed material or from material preserved in 70% ethanol. For dry pressed specimens, flowers were first soaked in a weak warm detergent solution prior to measuring while other measurements were taken directly from the specimen. All spirit specimens were measured wet. As mentioned earlier, frequent large variations in plant size and in other morphological characters occur within the genus due to environmental and seasonal conditions. This variation also occurs within and between populations. Therefore, measurements are presented as ranges compiled from specimens of several populations across the species distribution and from both dried and spirit materials. Most measurements were undertaken using a microscope graticule. Occasionally an estimate is given where an exact measurement was not possible. Stem length is the distance from the base of the plant just below basal leaves (i.e. ground level) to the uppermost bract pair while pedicel length is the distance from the uppermost bract pair to the base of the sepals. Stem bracts were measured when flattened out, but shape is described from the bracts when in situ on the stems. Sepal shape was described and measurements taken when in position on flowering specimens.

For each of the already named species within the section some additional description is given. These are not full descriptions, but intended as a supplement to the original descriptions where information and/or some measurements were lacking or where my range of measurements differs from that of the original descriptions and particularly to note additional diagnostic characters. All measurements were taken from dry pressed specimens across the species' distribution range. Most measurements were undertaken using a ruler rather than using a microscope graticule as above.

Flowering times for each species are based on specimen collections and to some extent may not be conclusive, particularly in the more arid regions where many plants are adapted to take advantage of opportunistic events.

SEM images were produced at The University of Western Australia's Centre of Microscopy on a LEO microscope. LEO parameters were set at high current (10kv) with a 60 micron aperture and a 24 mm working distance. Seed specimens were not coated before scanning. Images were subsequently enhanced using Photoshop 2.0 (see Figure 1).

Illustrations were drawn by L. Cobb and kindly funded by the Western Australian Herbarium, Department of Conservation and Land Management. In general, the illustrations are representative for each species and were assessed from Western Australian Herbarium specimens, spirit collections and photographs. For *Calandrinia lehmannii* and *C. primuliflora* only habit is portrayed because more detailed illustrations already exist in Diels & Pritzel (1905). Strictly speaking the illustrations do not always portray these species correctly at a particular moment in their stage of development. For instance, in some species the basal leaves commonly wither once flowering commences and are often fully dried off by fruiting. All illustrations show basal leaves in the non-withered condition regardless of what stage of flowering/fruiting that is portrayed.

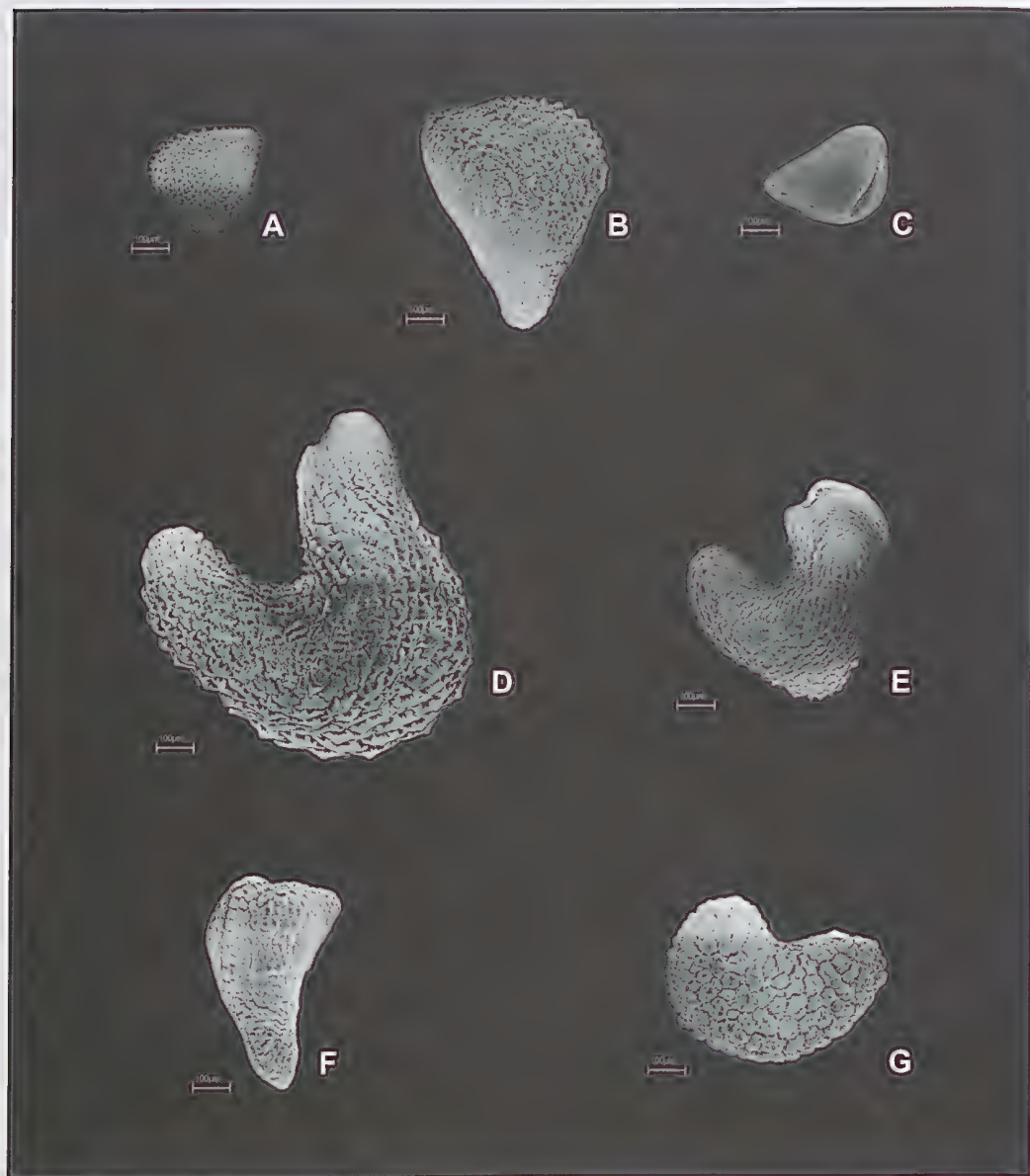


Figure 1. Scanning electron micrographs of seed of species in section *Tuberosae*. A – *Calandrinia crispisepala*; B – *C. kalanniensis*; C – *C. translucens*; D – *C. lehmannii* (from near Type locality); E – *C. lehmannii* (Northern & Eastern variants); F – *C. primuliflora*; G – *C. schistorhiza*. All are taken at the same magnification (scale bar = 100 micron).

Taxonomy

Key to species of *Calandrinia* sect. *Tuberosae*

A. Perennial, with tuberous rootstock (section *Tuberosae*)

1. Seeds black or grey black and strongly verrucose and/or tuberculate; sepals crisped; tuber taproot-like or appearing as a thickened root
 2. Flowers 10–18 mm diameter; seeds 0.2–0.3 mm long; usually smallish plant with narrow spatulate basal leaves 3.5–27.0 mm long (N of Mullewa to E of Mt Magnet and S to Paynes Find area) ***C. crispisepala***
 2. Flowers 25–40 mm diameter; seeds 0.5–0.8 mm long; usually a larger plant with broadly spatulate basal leaves 15–700 mm long and often with a strap-like petiole (widespread within the Eremaean Botanical Province) ***C. schistorhiza***
1. Seeds not black and moderately verrucose or smooth; sepals relatively smooth although may be sharply veined; a slender vertical root attached to tuber or tubers beneath
 3. Stigmata 3, free to base; flowers deep purple to magenta, floral throat constricted; usually a smallish plant (northern Avon Wheatbelt to Mt Magnet area) ***C. primuliflora***
 3. Stigmata 3, united onto a style; flowers white or pink, floral throat relatively open; small or medium sized plants
 4. Stem bracts narrowly acuminate (3.5–5.0 mm long), ± membranous, appressed, normally many pairs per stem; flowers white and shiny occasionally pale purple/mauve, summer flowering (extensive within the Avon Wheatbelt and extending into eastern goldfields) ***C. lehmannii***
 4. Stem bracts narrowly triangular to ovate (0.5–3.0 mm long), ± scarious, ± spreading, normally 3–5 pairs per stem; flowers pink occasionally bleached white, spring or summer flowering
 5. Flowers 15–25 mm diameter (often a yellow centre), spring flowering (occasionally early summer); seeds straw brown to light tan, translucent, triangular in outline, smooth, 0.25–0.35 mm long (northern Avon Wheatbelt and widespread in the Eremaean) ***C. translucens***
 5. Flowers 5–12 mm diameter (often a white centre), summer flowering (occasionally late spring); seeds off-white and light brown, pyramidal and roughly trigonous, opaque, moderately verrucose, 0.5–0.8 mm long (W of Paynes Find, Kalannie area & NE of Mukinbudin) ***C. kalanniensis***

A. Annual, or if perennial then lacking a tuberous rootstock (sections *Basales* and *Pseudodianthoideae*)

Calandrinia crispisepala* Obbens, *sp. nov.

C. schistorhiza affinis sed planta erecta vel semi-erecta (nec prostrata vel decumbenti), et parviore, foliis basalibus anguste spathulatis, floribus 10–18 mm diam. differt.

C. crispisepala has affinities to *C. schistorhiza*, but differs in the plant being erect to semi-erect (rather than prostrate to decumbent), is smaller, has narrow spathulate basal leaves and flowers 10–18 mm in diameter.

Typus: Circa 9.2 km E of Yalgoo, Western Australia, 14 October 2003, *F. Obbens* FO 72/03 (*holo*: PERTH 06708307; *iso*: CANB, K).

Perennial herb; root system completely tuberous (i.e. taproot-like, but occasionally the tuber is branched). *Plant* semi-erect to erect, sometimes prostrate, 10–38 mm tall \times 25–80 mm wide, glabrous. *Basal leaves* fleshy, narrowly spathulate, 3.5–27.0 mm long \times 0.7–2.2 mm wide at widest point. *Stems* few to many (usually 7–16), radiating out and upwards from base, 115–270 mm long, bare except for 3 to 4 or occasionally more pairs of opposite \pm scarious bracts; the lowest node sometimes with 3 bracts. *Stem bracts* \pm spreading, triangular to ovate occasionally narrowly so, 0.7–2.2 mm \times 0.7–2.2 mm, apex obtuse to acuminate with mid vein extending down central fold; one bract of lowest stem node with a double apex, each apex with a mid vein as above (see Figure 2). *Inflorescence* of 1 (occasionally 2) terminal pedicellate flower, very occasionally branching below. *Pedicel* 3.0–6.0 mm long, erect, slightly reflexed in fruit. *Flowers* 10–18 mm diameter. *Sepals* thin, ovate to broadly ovate, 3.1–6.6 mm \times 2.5–5.4 mm, 3-nerved, free to base, extensively wrinkled or creased. *Petals* 5, bright pink to purple in apical half and white in basal half, obovate to flabellate (sometimes broadly so) with an emarginate or depressed apex, 5.9–12.3 mm \times 3.2–9.6 mm, shortly connate at base. *Stamens* 38–44 in 2 or 3 ill-defined rows; filaments free, 1.7–3.6 mm long, attached to a basal cup beneath the ovary; anthers elliptic to oblong in outline, 0.6–1.2 mm \times 0.25–0.6 mm, versatile, extrorse, dehiscing longitudinally. *Ovary* spheroid to ovoid, 1.4–2.3 mm \times 1.3–2.3 mm. *Style* 0.3–1.3 mm long; stigmata 3, 1.6–3.9 mm long, shortly plumose. *Capsule* ovoid to slightly pyramidal, sometimes broadly so, 3.0–5.0 mm \times 2.4–3.4 mm, apex obtuse or occasionally truncate, usually not protruding beyond the sepals; valves 3, splitting from apex to base. *Seeds* numerous (100+), black, dull, heart-shaped and somewhat trigonous, 0.2–0.325 mm \times 0.2–0.275 mm, surface strongly and minutely verrucose and tuberculate. (Figures 1A, 2)

Other specimens examined. WESTERN AUSTRALIA: 4 miles S of Mt Magnet, 23 Oct. 1973, *H. Demarz* 4682 (KPBG); Bullardoo Station, N of Mullewa, 7 Oct. 2004, *F. Hort, J. Hort & J. Shanks* 2359 (PERTH 06873995); Burnerbinmah Station, NW of Paynes Find, 21 Oct. 1998, *S. Patrick et al.* 3044 (PERTH 05407524); 80 km W of Sandstone, 19 Oct. 1992, *L. Sweedman* S2338 (KPBG); Windimurra Station, [ESE of Mt Magnet], 11 Sep. 1992, *S. Van Vreeswyk* 3014 (PERTH 04267214).

Distribution. Eremaean Botanical Province of Western Australia. Known only from the above collections, but range may extend further. Distribution is roughly from N of Mullewa to E of Mt Magnet and then S to Paynes Find area. (Figure 8A)

Habitat. Recorded in red sandy clay soils on an eroded lateritic platform or on plains with red clayey sand over hardpan. Some sites are described as stony or as having iron-rich pebbles or rocks scattered on the surface. Occurs in very open shrubland or mulga.

Phenology. Flowers and fruits in September to October.

Conservation status. Probably a fairly common species with a relatively wide distribution. Most *C. crispisepala* habitat is affected by pastoral grazing, although some leases have recently been transferred to conservation reserves (e.g. Burnerbinmah and Twin Peaks Stations).

Etymology. From the Latin *crispus* – wrinkled or creased and *sepala* – sepals. This is seen more obviously in the dry state.

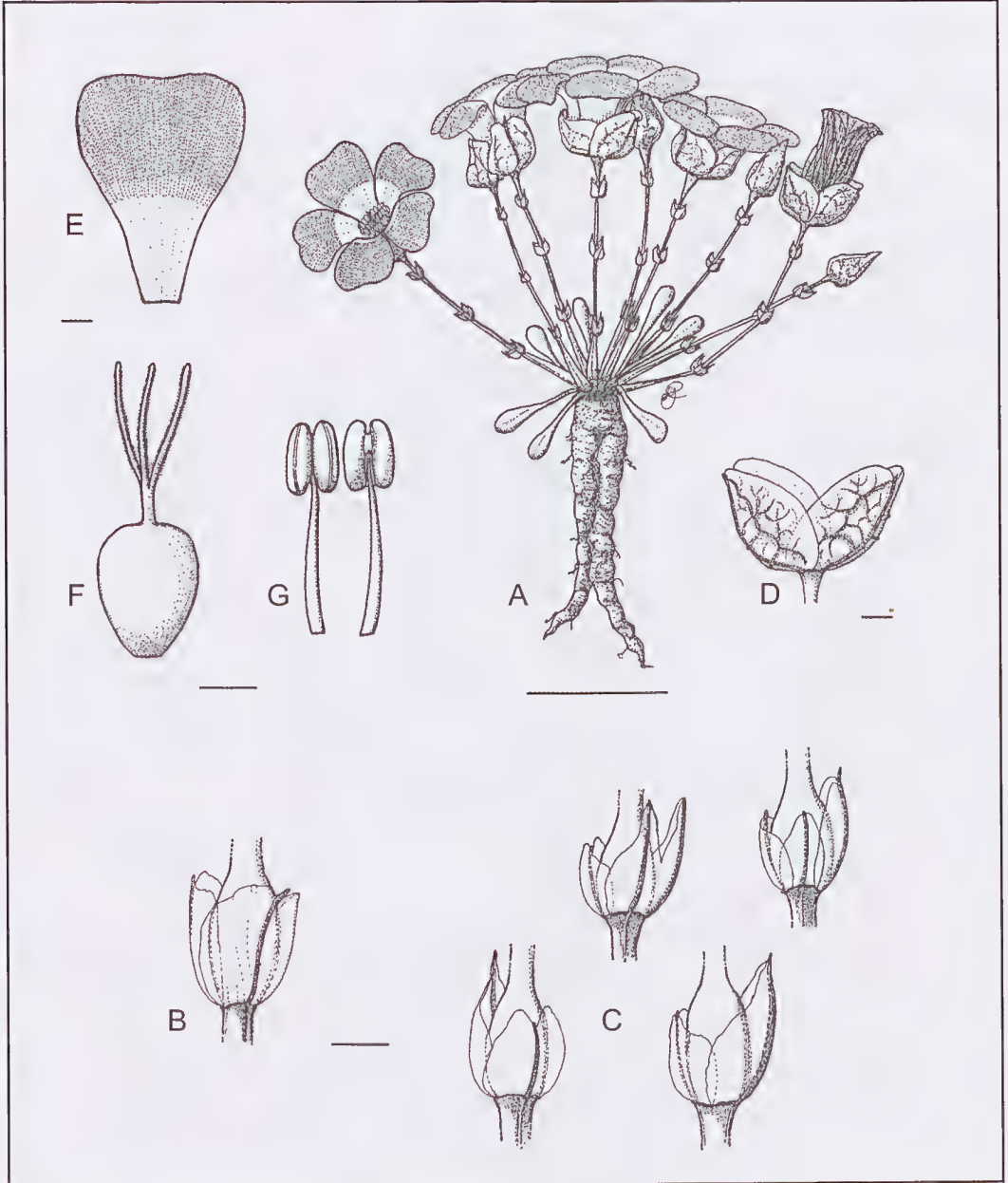


Figure 2. *Calandrinia crispisepala*. A – plant habit displaying a tap-root like tuber; B – upper stem bract; C – lower stem bracts; D – sepals; E – petal; F – gynoecium; G – stamens. Scale bars: A = 10mm; B–G = 1mm.

Notes. This species is probably most closely related to *Calandrinia schistorhiza* Morrison, since the two have similar seed, sepal and tuber characteristics (i.e. seeds black and strongly verrucose, sepals similarly crisped and tubers taproot-like or appearing as a thickened root). However, *C. schistorhiza* is a larger plant in all respects when compared to *C. crispisepala*, although *C. crispisepala* maybe confused with *C. primuliflora* because of their similar size and habit (see also notes under *C. primuliflora*).

Calandrinia kalanniensis* Obbens, *sp. nov.

C. primuliflora affinis sed stigmatis 3 in stylo connatis, floribus roseis vel pallide roseis, fauce florali comparate aperta differt.

C. kalanniensis has affinities to *C. primuliflora*, but differs in having 3 stigmata fused onto a style, flowers pale to mid pink and a relatively open floral throat.

Typus: Hughden Rock, c. 1.7 km N on Struggle Street from junction with Dalwallinu–Kalannie road, Western Australia, 19 January 2004, *F. Obbens* FO 3/04 (*holo:* PERTH 06707971; *iso:* CANB, K).

Perennial herb; root system a narrow vertical root attached to a tuber beneath (occasionally the tuber branched). *Plant* semi-erect to erect, 20–85 mm tall × 10–45 mm wide, glabrous. *Basal leaves* fleshy, linear-terete to narrow-spathulate, 1.1–8.2 mm × 0.3–1.4 mm at widest point. *Stems* one to several, radiating out and upwards from base, 12–75 mm long, bare except for 3 to 5 or occasionally more pairs of opposite ±scarious bracts. *Stem bracts* ±spreading, narrowly triangular to narrowly ovate (sometimes broader), 0.9–2.8 mm × 0.6–2.5 mm, apex acute to acuminate, strongly recurved. *Inflorescence* of 1 (occasionally 2) terminal pedicellate flower, occasionally branching below. *Pedicel* 1.2–4.2 mm long, erect, sometimes obscured by the uppermost bracts, moderately reflexed in fruit. *Flowers* 5–12 mm diameter. *Sepals* thin, ovate, 2.6–3.4 mm × 1.7–2.7 mm, strongly 3-veined, free to base. *Petals* 5, pale to mid pink usually with some white at base (sometimes appearing totally white), obovate to spatulate, occasionally broadly so, 5.4–6.3 mm × 2.2–4.0 mm, connate basally up to one third. *Stamens* 33–40 in 2 or 3 ill-defined rows; filaments free, 0.6–3.2 mm long, attached to a basal cup beneath the ovary; anthers elliptic to oblong in outline, 0.45–0.65 mm × 0.3–0.5 mm, versatile, extrorse, dehiscing longitudinally. *Ovary* ovoid, 1.3–1.4 mm × 0.85–1.2 mm. *Style* 0.4–0.9 mm long; stigmata 3, 1.1–2.2 mm long, shortly to moderately plumose. *Capsule* pyriform, truncate at apex giving a pore-like appearance, 3.3–4.2 mm × 1.9–2.7 mm, slightly protruding beyond the sepals; valves 3, splitting to one third or half. *Seeds* 6–37, off-white and light-brown, dull, pyramidal and roughly trigonous, 0.5–0.8 mm × 0.4–0.65 mm, moderately verrucose (particularly at one end). (Figures 1B, 3)

Otherspecimens examined. WESTERNAUSTRALIA: Xantippe Rock, c. 30 km E of Dalwallinu on Kalannie Rd, 8 Jan. 2004, *R. Cranfield* s.n. (PERTH 06235069); Petrudor Rock, c. 16 km directly SW of Kalannie townsite, (a) 12 Oct. 2003 (b) 3 Jan. 2004 (c) 19 Jan. 2004, *F. Obbens* FO 60/03 (PERTH 06708129, PERTH 06708137, PERTH 06708145); Yannemooning Rock in rock garden near summit, NE of Mukinbudin, 15 Oct. 2005, *F. Obbens & H. Jensen* FO 2/05 (PERTH 07213093); Granite outcrop beside Elsewhere Rd near junction with Cunderdin Rd, NE of Mukinbudin, 16 Oct. 2005, *F. Obbens & H. Jensen* FO 5/05 (PERTH 07213123); Near Blue Hills Range, Karara Station, 14 Nov. 2005, *G. Woodman & K. Rodda* M13-3 (PERTH 07215568).

Distribution. South West and Eremaean Botanical Provinces of Western Australia. Originally known from only three locations NW and SW of Kalannie, however, more collections have been made recently from Karara Station, W of Paynes Find and from NE of Mukinbudin. This extends the distribution much further than previously recognized. (Figure 8B)

Habitat. Recorded in shallow brown clay soils often gritty and derived from eroded granite. All collections are from the apron areas of granite outcrops or soil pockets on granite. Occurs in open herbfields often surrounded by *Acacia* shrubland.

Phenology. Flowers and fruits in mid November to January.

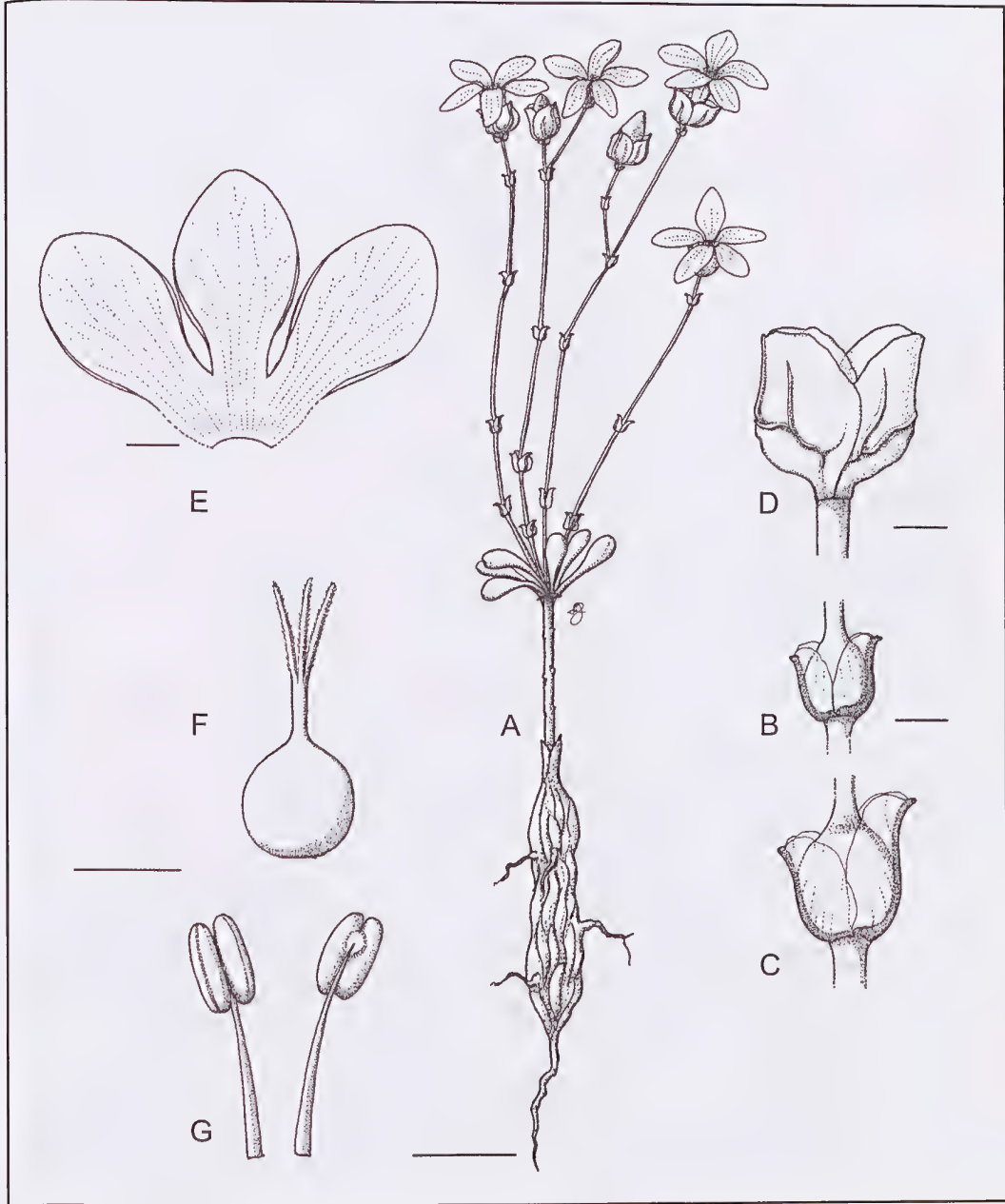


Figure 3. *Calandrinia kalanniensis*. A – plant habit displaying a narrow vertical root attached to a tuber beneath; B – upper stem bract; C – lower stem bract; D – sepals; E – petals; F – gynocium; G – stamens. Scale bars: A = 10mm; B–G = 1mm.

Conservation status. Conservation Codes for Western Australian Flora: Priority Two. Currently, there are 6 known populations over a relatively wide area. There are many granite rocks within this region and it is likely that future survey of these should produce other collections of this species.

Etymology. Named after the closest town, Kalannie where the original collections were discovered.

Notes. This species is possibly most closely related to *Calandrinia primuliflora* both having some seed, capsule and sepal characters in common (i.e. seeds of similar colour and surface patterning, capsules with truncated apices and with limited valve separation and sepals with 3 distinct, raised and folded nerves).

In many other characters there is little similarity between the two. For example, *C. kalanniensis* has obovate petals and stigmata united onto a style whereas *C. primuliflora* has broadly suborbicular petals and stigmata free to base. Also *C. kalanniensis* might be confused with *C. translucens* because of their somewhat similar habit.

Calandrinia translucens* Obbens, *sp. nov.

C. lehmannii primo aspectu maxime similen sed floribus roseis in vere florenti, seminibus laevibus translucenitibus differt.

C. translucens has been confused with the superficially similar *C. lehmannii*, but differs in having pink flowers, flowering during spring and also has smooth translucent seeds.

Typus: 45.8 km N of Wubin townsite on Great Northern Highway, Western Australia, 9 November 2003, F. Obbens FO 65A/03 (*holo:* PERTH 06708226; *iso:* CANB, K). Cultivated (i.e. on-grown) from plants collected at the above location. Plants harvested when in flower.

Perennial herb; root system a narrow vertical root attached to a tuber (occasionally the tuber branched). *Plant* semi-erect or erect or occasionally almost prostrate, 15–175 mm tall × 15–170 mm wide, usually glabrous. *Basal leaves* fleshy, narrow-spathulate, 0.9–36 mm × 0.3–2.5 mm at widest point. *Stems* few to many (usually 4–9), radiating out and upwards from base, 12–75 mm long, bare except for 3 to 10 (normally 5) pairs of opposite ± scarious bracts. *Stem bracts* ± spreading, triangular to ovate, 0.6–2.7 mm × 0.4–2.6 mm, apex acute to acuminate sometimes recurved. *Inflorescence* a multi-flowered loose cyme (juveniles can be one or few flowered). *Pedicel* 2.7–11.2 mm long, erect, moderately reflexed in fruit. *Flowers* 15–25 mm diameter. *Sepals* thin, ovate, 2.1–5.6 mm × 1.5–3.1 mm, 3–5 veined, free to base. *Petals* 5, pale to mid pink (some may bleach white), often yellow at base with obvious dark pink or purple striations outside at least on the two enveloping petals when in bud, obovate, occasionally narrowly so, 6.3–12.6 mm × 2.6–5.4 mm, shortly connate at base. *Stamens* 20–72 in 2 or 3 ill-defined rows; filaments free, 0.8–4.2 mm long, attached to a basal cup beneath the ovary; anthers elliptic to oblong in outline, occasionally broadly so, 0.5–0.9 mm × 0.4–0.6 mm, versatile, extrorse, dehiscing longitudinally. *Ovary* ellipsoid to ovoid, 1.7–2.8 mm × 0.9–1.8 mm. *Style* 0.7–2.0 mm long; stigmata 3, 0.8–2.2 mm long, shortly to moderately plumose. *Capsule* ovoid, occasionally slightly pyriform, apex obtuse, sometimes narrowing, 3.0–4.6 mm × 1.5–2.3 mm, usually protruding beyond the sepals; valves 3, initially splitting only at summit, usually fully splitting with age. *Seeds* 80–100+, straw-brown to light-tan, semi-glossy and translucent, triangular in outline with 2 grooves running parallel along 2 edges, 0.3–0.4 mm × 0.2–0.3 mm, smooth. (Figures 1C, 4)

Other specimens examined. WESTERN AUSTRALIA: Near Mangilla Bore, c. 40 km directly SE of Leinster, 13 Oct. 2004, *P. Armstrong* Rainbow PA 20 (PERTH 07219040); Meekatharra airport, 22 Nov. 1992, *M.D. Barrett* MDB 47 (PERTH 02859955); On Wanna Munna flats, Fortescue [Pilbara], 15 Oct. 1965, *J.V. Blockley* 119 (KPBG); Coolcalalaya Station, NW corner, 21 Oct. 1995, *M.N. Lyons* 2433 (PERTH 04994043); 8.5 km E of NW Coastal Highway and 14.4 km N of Nerren Nerren Station turnoff, 23 Oct. 1995, *M.N. Lyons* 2442 (PERTH 04994140); Dawson Paddock, Burnerbinmah Station, NW of Paynes Find, 23 Oct. 1998, *G. Marsh et al.* 301A (PERTH 05490456); 2 km SSE of Hogans Lagoon on Lake Lefroy, near Kambalda, 11 Dec. 1997, *A.A. Mitchell* 5100 (PERTH 05908345); 45.8 km N of Wubin townsite on Great Northern Highway, Western Australia, 20 Jan. 2004, *F. Obbens* FO 65B/03 (PERTH 06708234).

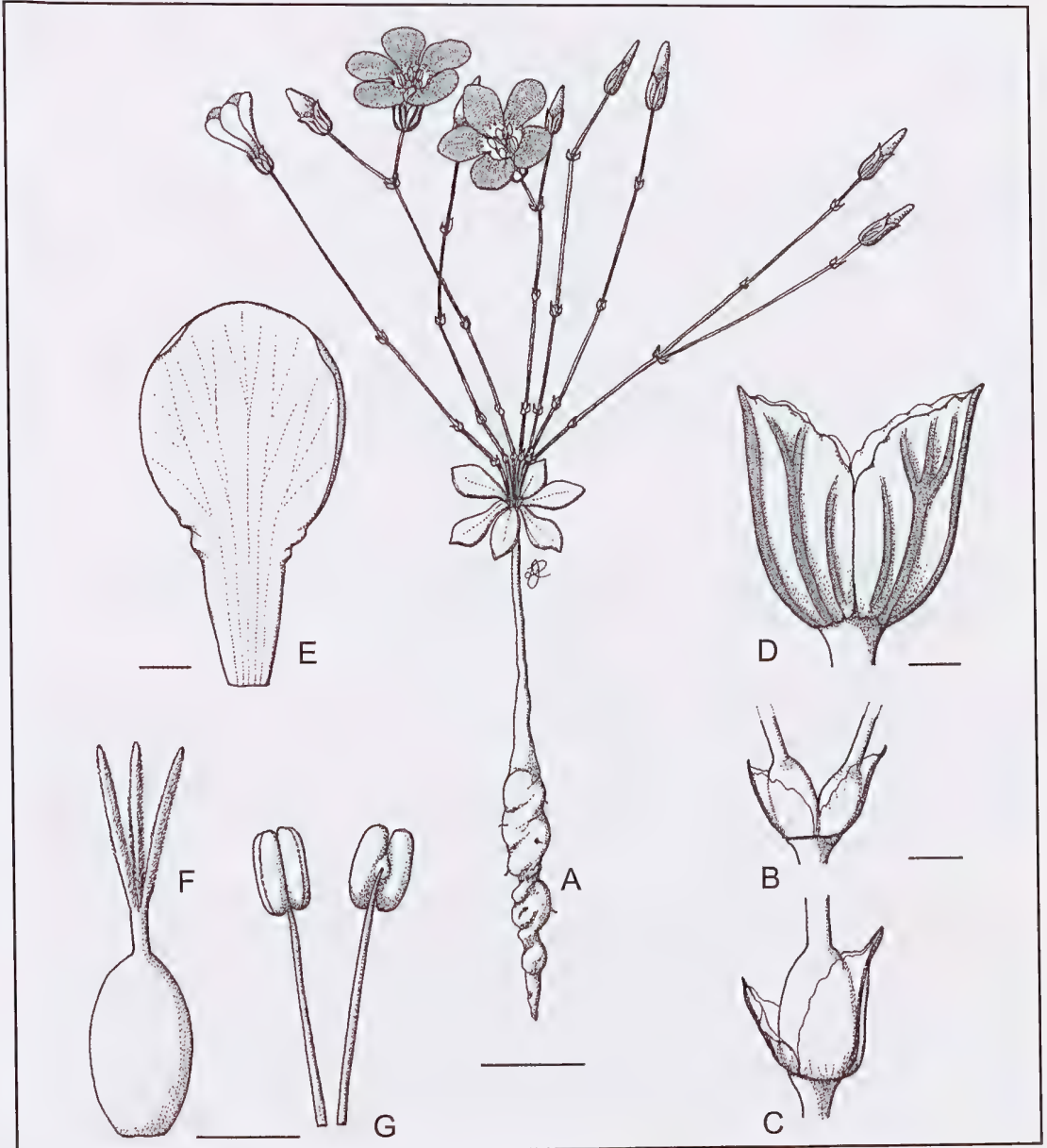


Figure 4. *Calandrinia translucens*. A – plant habit displaying a narrow vertical root attached to a tuber beneath; B – upper stem bract; C – lower stem bract; D – sepal; E – petal; F – gynoecium; G – stamens. Scale bars: A = 10mm; B–G = 1mm.

Distribution. A widespread species of the northern Avon Wheatbelt and Eremaean Botanical Province. In the latter it ranges from the Goldfields to the Pilbara and further east into desert areas. (Figure 8C)

Habitat. Recorded in orange to red clayey sand or in sand over clay soils. Occurs in a variety of habitats including open shrublands, amongst open vegetation fringing pans or salt lakes and in the understorey of very open *Eucalyptus loxophleba* woodland.

Phenology. Flowers and fruits in September to November (occasionally in early December).

Conservation status. This taxon has an extensive distribution and is found in several habitats and there is a high probability that it is quite common, but has been under collected throughout much of its range.

Etymology. From the Latin for translucent, in reference to the seeds.

Notes. Superficially, *Calandrinia translucens* has a similar habit to *Calandrinia kalanniensis* although it is generally a larger plant. The flower size of *C. translucens* and sometimes even the shape can be somewhat similar to that of *C. lehmannii*, although the obovate petals of *C. translucens* are quite variable with the apex being rounded to bluntly acute (see notes under *C. lehmannii*). *Calandrinia translucens* is distinctive in having smooth translucent seeds.

The specimen *F. Obbens* FO 65B/03 comes from the exact Type location and is material collected later on when these plants were in late seed. It is not part of the Type material. Additionally, the specimen *M.N. Lyons* 2442 is slightly unusual in having dense and shortly pilose to glandular hairs on the sepals and pedicels, however, it is typical of *C. translucens* in all other respects.

Calandrinia lehmannii Endl. in Lehm. Pl. Preiss 2: 235 (1848). *Type citation*: "In solo sublimoso-glareoso prope paludem Barrelanjin (in fluvio Avon) haud longe a Vilemattin v. Davy's place (York) 26. Febr. 1839. Herb. Preiss. No. 1528. (Endl.)." (*holo*: LD n.v.; *iso*: !MEL 110919).

There are no records referring to Barrelanjin (whether a lake, a river pool or a river backwater, etc.) in Western Australia. However, Battye Library records show the Davy's property to have been located between the lower slope of Mt Bakewell and the Avon River, York. Much of this area is now cleared or modified for agriculture while very few native remnants remain and these are mostly in a disturbed condition. A search of parts of this area during summer 2004 failed to find any *Calandrinia lehmannii* and it is likely to have become locally extinct here.

Perennial herb; root system complex usually consisting of multiple tubers interconnected by slender roots (fewer tubers relatively common), sometimes appearing like a string of beads. *Plant* erect, 45–200 mm × 15–50 mm (i.e. small to medium sized), glabrous. *Basal leaves* fleshy, narrow-spathulate to linear, 5–10 mm long × 1–5 mm at widest point. Individual plants frequently single-stemmed, occasionally up to 3 stems, normally few branched and few flowered although some mature plants or those with larger tubers can be multi-branched and several flowered. *Stems* with numerous bract pairs, internodes short with bract pairs occasionally overlapping. *Stem bracts* appressed, ±membranous, narrowly triangular to ovate, 3.5–5 mm long with a long acuminate apex. *Inflorescence* usually of 1 to 3 terminal pedicellate flowers, if with several flowers forming loose cymes. *Pedicel* 4–16 mm, erect, slightly deflexed in fruit. *Flowers* 10–26 mm diameter. *Sepals* thin, broadly elliptic to broadly ovate, usually 5-nerved although the outer 2 often appear indistinct amongst the reticulation. *Petals* 5, normally white (see notes below),

6–14 mm long, elliptic to obovate and often with light brown striations particularly on the two enveloping petals when in bud. *Stamens* numerous; filaments free; anthers versatile. *Ovary* ellipsoid to ovoid, sometimes narrowly so; stigmata 3, shortly to moderately plumose and united onto a style equal to or slightly less than the length of the stigmata. *Capsule* ovoid, 3–6 mm \times 1.5–2.5 mm, somewhat erect with 3 valves splitting fully to base. *Seeds* several to numerous, usually >20 , crescent to U-shaped, normally dull light brown, verrucose and partly tuberculate, 0.5–1.0 mm long. (Figures 1D, 1E, 5)

Specimens examined. WESTERN AUSTRALIA: Coalseam Reserve, upstream from Miners Camp [Mingenew area], 17 Feb. 2003, G. Byrne 1 (PERTH 06451950); Emu Rock [near Hyden], 9 Apr. 1997,

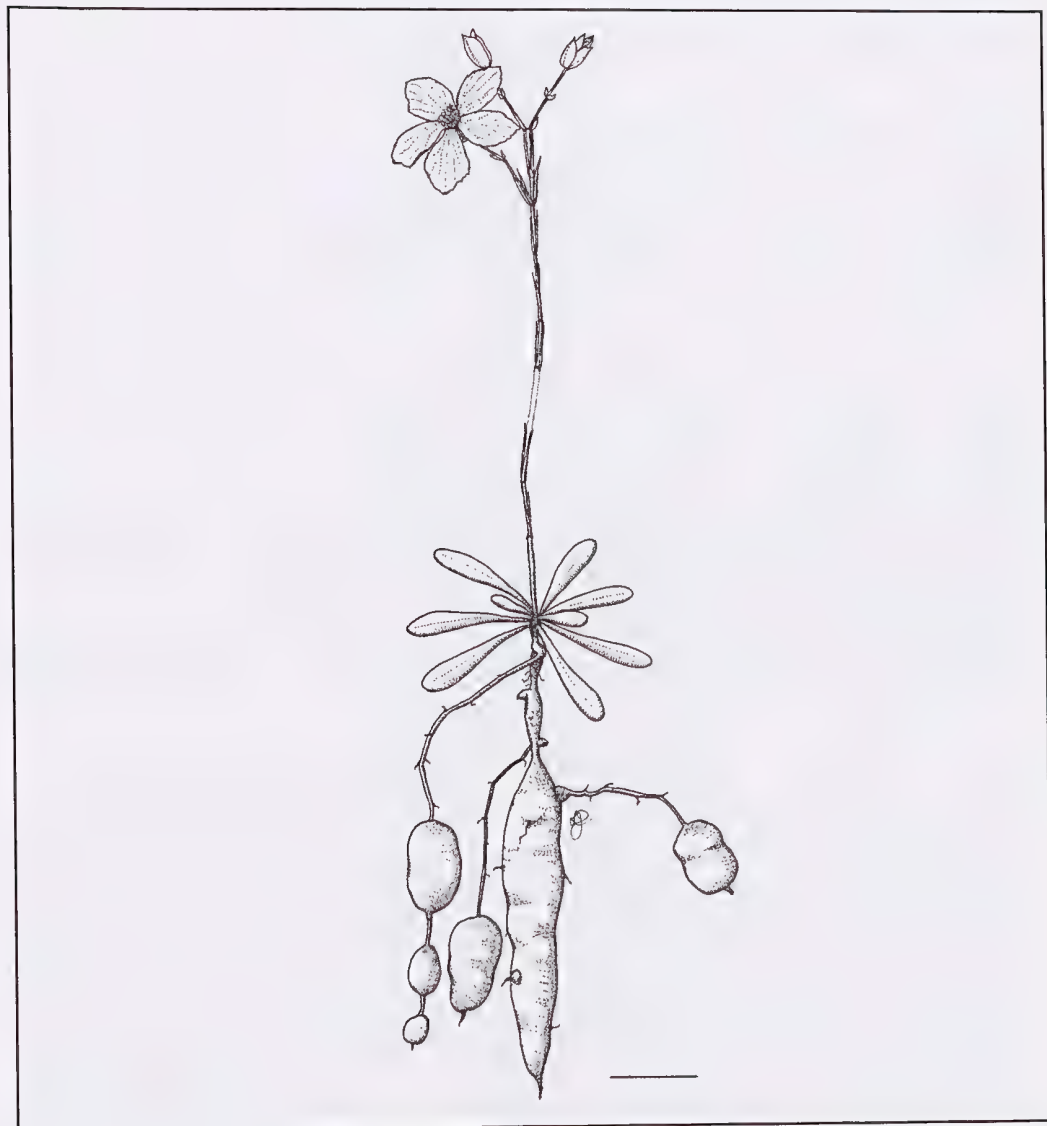


Figure 5. *Calandrinia lehmannii*. Plant habit displaying the intricate root system consisting of tubers interconnected by narrow roots. Scale bar = 10mm.

R. Cranfield 11298 (PERTH 04695623); Broomehill townsite reserve, 1987, *R. Garstone s.n.* (PERTH 05699215); Yanneymooring Hill 40 km NE of Mukinbudin, 24 Feb. 1993, *K.F. Kenneally* 11357 (PERTH 02999293); 29 km SSW of Norseman, 13 Mar. 1980, *K. Newbey* 6733 (PERTH 04209087); Beverley Airfield Reserve, 10 Jan. 2004, *F. Obbens* FO 1/04 (PERTH 06707955); Petrudor Rocks [near Dalwallinu/Kalannie], 19 Jan. 2004, *F. Obbens* FO 2/04 (PERTH 06707963); c. 1.2 km N along Buntine Rock track [Buntine area], 20 Jan. 2004, *F. Obbens* FO 4/04 (PERTH 06707998); Kokeby Water Reserve [near Beverley], 29 Dec. 2001, *T. Watson* 51 (PERTH 06359159).

Distribution and habitat. Extensive within the Avon Wheatbelt and extending into the eastern goldfields areas. Frequently associated with exposed granite sheets or shallow soils over granite. In these habitats the species occurs as part of a herbfield community often surrounded by *Acacia* or *Melaleuca* species. It has also been found in open shrublands and in open wandoo or mixed woodlands on sandy clay soils. One collection was located near a river. (Figure 8D)

Phenology. Flowers and fruits in January to March (occasionally April).

Conservation status. This taxon is relatively common, but likely to be under-collected due to its summer flowering. *C. lehmannii* has a wide distribution and although much of its range is now agricultural there are still numerous remnants or reserves dotted throughout this cleared Avon region where it is likely to occur.

Etymology. Named after the noted German botanist Johann Georg Christian Lehmann (1792 – 1860).

Notes. *Calandrinia lehmannii* has frequently been confused with *C. translucens*, both having a similar flower size and sometimes a similar shape, however, *C. lehmannii* flowers are commonly white while *C. translucens* are usually bright mid pink. Endlicher described the petals inside as covered with white sericeous hairs and later Diels and Pritzel (1905) stated that the flower was pale purple and shiny inside with the outside yellowish. However, my own observations at several localities indicate that the flower is white, but occasionally at closer inspection appears tinged pale purple/mauve and is indeed somewhat shiny. Examination of several specimens including the isotype did not reveal any sericeous hairs, although the corolla throat is often papillate to shortly pilose. No other specimens examined in this section appear to have this characteristic. Diels and Pritzel's description might be explained if their observations were of an unusually deeper coloured variant while it is also common for *C. lehmannii* flowers to yellow quickly when pressed.

Many other of its characters are quite different to those of *C. translucens* and to other members of the section. For example, *C. lehmannii* normally has a very erect habit, flowers during summer, often has light brown striations on the petals (particularly the two enveloping petals when in bud), and has numerous acuminate stem bracts. These opposite bract pairs are appressed and ±membranous, while others in the section are ±scarious. Most specimens are single stemmed and few flowered, however, Diels and Pritzel illustrate a more mature multi-flowered specimen and fail to show the lower stem and intricate root system. These distinctive features have been included in the illustration of *C. lehmannii* (Figure 5).

C. lehmannii may have the ability to clone off new plants. A few specimens examined display slender horizontal roots growing from a single tuber and leading to separate stems above ground level. When these stems are tightly clustered the plant appears as a multi-stemmed individual above ground. However, if these stems are spaced some distance apart they appear as separate individuals and may form new cloned plants if the initial connection breaks and the new plant forms its own tuber. This characteristic may not be unique within the section, for some recent collections of *C. primuliflora* and

C. translucens also display the start of an extended horizontal root similar to the above. Further investigations are required to determine whether or not asexual reproduction truly occurs and whether this is biological or a response to environmental factors such as drought.

An examination of seed shows the *C. lehmannii* collection from Beverley (just south of the Type locality) to be significantly larger-seeded than collections further north and east (Figure 1D & 1E). This might indicate clinal variation, polyploidy or an environmental affect. More research is required to determine if these entities should be formally recognized.

Calandrinia primuliflora Diels, Bot. Jahrb. Syst. 35: 198 (1904). *Type citation*: “Hab. In distr. Irwin a Northampton septentrionem versus in rupium graniticarum fissuris lutosus non nisi uno loco (ibi socialis) observata flor. m. Nov. exeunte (D. 5649).” (*holo*: B, destroyed; *iso*: PERTH, *n.v.*).

The exact Type location is unknown, but the collection was made near Northampton (i.e. c. 52 km N of Geraldton) from a granite outcrop area in November 1901. In the late 1930's, C.A. Gardner, Chief Botanist of the Western Australian Herbarium, obtained a portion of the Type (i.e. an isotype) from Berlin. This is now on loan to the Australian National Herbarium, Canberra, while the original 'holotype' was destroyed during World War II. I have not seen the isotype, however, the illustration from Diels' original publication clearly enables the species to be identified.

Perennial herb; root system a narrow vertical root attached to a tuber beneath. *Plant* erect or semi-erect to decumbent, 10–40 mm × 10–90 mm, glabrous. *Basal leaves* fleshy, spatulate, 3–15 mm × 0.5–5 mm at widest point. *Plant* normally with 3–15 stems, very occasionally once branched below the inflorescence. *Stems* with 4–7 bract pairs; stem bracts ±spreading, ±scarious, triangular to ovate, 1–2.5 mm long. *Inflorescence* a terminal solitary flower on a very short erect pedicel 0.5–2.0 mm long that is largely obscured by the uppermost pair of stem bracts. *Pedicel* and the adjacent lower stem portion moderately to strongly deflexed in fruit. *Sepals* thin, normally whitish, greenish or light brown, or a combination thereof, ovate to broadly ovate, strongly 3-nerved (nerves raised and folded) with no interconnecting reticulation. *Petals* 5, normally deep purple to magenta, whitish near the ovary, 4–12 mm long, broadly suborbicular and often with a slightly crenulate apex. *Stamens* numerous; filaments free; anthers versatile. *Ovary* spheroid to ellipsoid; stigmata 3, moderately to densely plumose, free to base. *Capsule* ovoid/pyriform, 3–4 mm × 1.5–2 mm, truncate at apex giving a pore-like appearance, 3 valved. *Seeds* off-white or light yellow-brown, somewhat pyramidal, slightly curved and moderately verrucose, 0.5–0.7 mm long. (Figures 1F, 6)

Specimens examined. WESTERN AUSTRALIA: 182 km from Mt Magnet on Geraldton Rd, 1 Nov. 1963, D.W. Goodall 1989 (PERTH 06635954); Canna Nature Reserve, 26 Oct. 1998, G.J. Keighery & N. Gibson 7127 (PERTH 06802346); Carnamah, 4 Nov. 1906, A. Morrison (PERTH 03332837); 28 km W of Mt Magnet, 7 Oct. 1989, B. Nordenstam & A. Anderberg No. 433 (PERTH 01962302); c. 7.5 km W of Mongers Lake causeway on the Paynes Find–Yalgoo road, 13 Oct. 2003, F. Obbens FO 67/03 (PERTH 06708250); near SE cnr of Lochada Nature Reserve, 1 Oct. 1995, S. Patrick *et al.* 2488 (PERTH 05949335); 7.9 km S of Gutha East Rd and 0.2 km N of Fitzgerald Rd on Morawa–Yalgoo road, 13 Oct. 2003, B.L. Rye & M.E. Trudgen BLR 231012 (PERTH 06588379); Pullagaroo Station [E of Paynes Find], 15 Oct. 1993, S. Van Vreeswyk 30034 (PERTH 04429575).

Distribution. Occurs within the northern parts of the Avon Wheatbelt region (SW Botanical Province) and parts of the Yalgoo and Murchison regions (Eremaean Botanical Province). (Figure 8E)

Habitat. Often found on aprons of granitic rocks on gritty sandy soils, but also known to occur on heavier soils (e.g. claypans or eroded loams of lateritic plains or low ridges). Always appears to be within herbfields or open shrubland communities.

Phenology. Flowers and fruits in October to November.

Conservation status. A number of collections exist from a relatively wide area including some from conservation reserves. The species appears to be relatively common over its range.

Etymology. The name refers to its supposed resemblance to plants of the genus *Primula*.

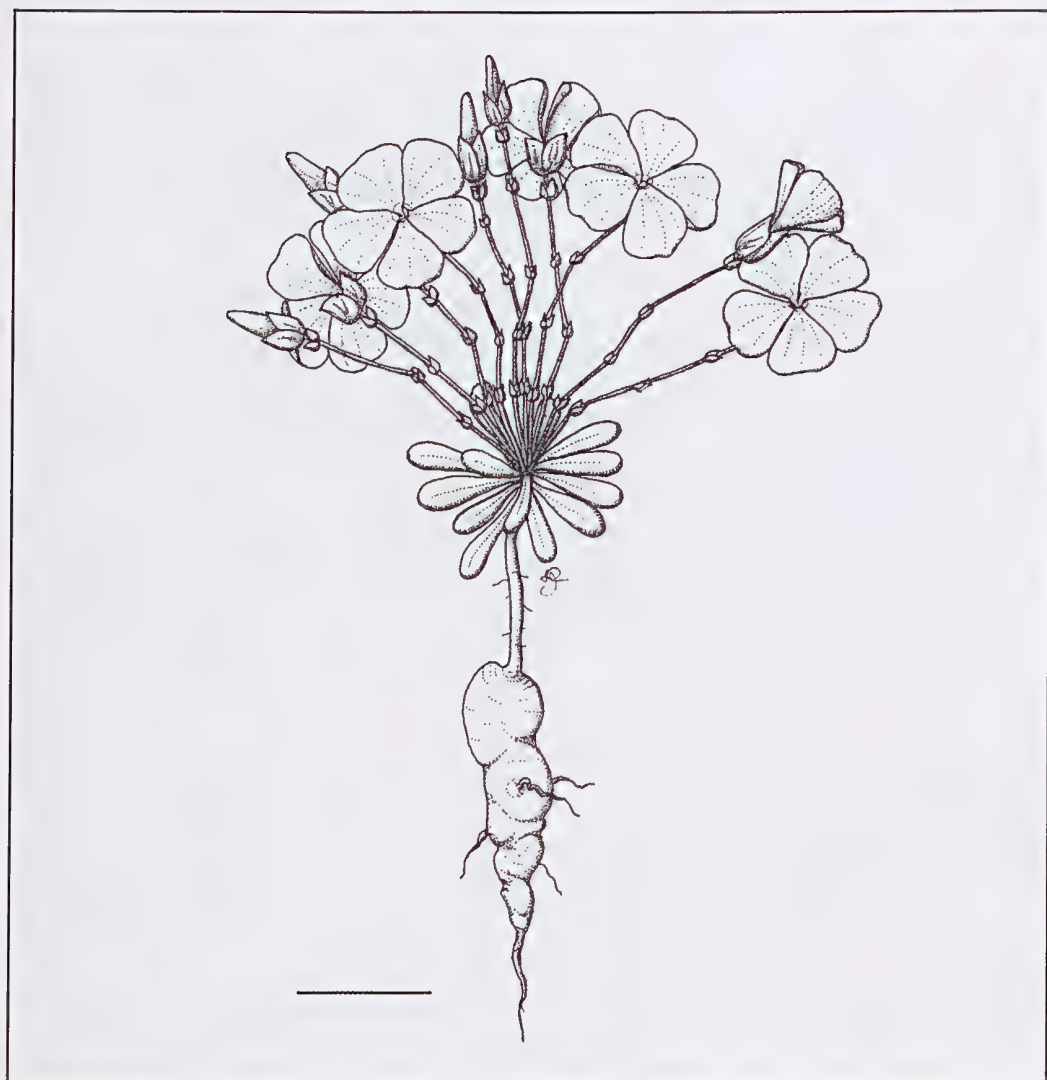


Figure 6. *Calandrinia primuliflora*. Plant habit displaying the root system consisting of a narrow vertical root attached to a tuber beneath. Scale bar = 10mm.

Notes. It might be possible to confuse *Calandrinia primuliflora* with *C. crispisepala* as both are small-sized plants with partially overlapping distributions. When in flower they are easy to distinguish because *C. primuliflora* has a constricted floral throat while *C. crispisepala* has an open floral throat with a large and distinctive white centre. Seeds of the two species are very different (*cf.* Figure 1A & 1F) and so too are their root systems (*cf.* Figures 2 & 6). *C. primuliflora* has deep purple or magenta flowers whereas all the others members of this group have pink, white or pale mauve to pale purple flowers. *C. primuliflora* is the only species in this section with stigmata free to base and it has distinctive whitish sepals that are strongly three-veined. *C. primuliflora* and *C. kalanniensis* are the only two species in this section that have similarly shaped capsules, both appearing to have a pore-like apex and valves that split to about a third of their length (i.e. at least initially, but these may split more fully with age). Both also have sepals with 3 prominent veins and somewhat similar seeds (i.e. shape and colour). However, *C. kalanniensis* is quite different to *C. primuliflora* in having a higher degree of petal fusion (i.e. up to a third the petal length) and a habit more akin to *C. translucens*.

Diels' original illustration of *C. primuliflora* is a reasonable representation, but the illustrator has used some artistic licence in drawing reproductive structures (i.e. stamens) above the floral throat. It is sometimes possible to observe the reproductive structures from above the flower, but it is most unlikely that the illustrated specimen would have displayed this characteristic from the angle it was drawn. Figure 6 above provides a more realistic representation of *C. primuliflora*.

Calandrinia schistorhiza Morrison, J. Bot. 50: 164 (1912). *Type citation*: "Boulder, Sept.; W.D. Campbell." (*holo*: BM, *n.v.*).

The exact Type location is unknown, however, Mr. Campbell apparently collected the specimens from a dry rocky place at Boulder in September 1900. He informed Morrison that the habitat was similar to that of *C. primuliflora*. Morrison's description of *C. schistorhiza* stated its close affinity to *C. primuliflora* except for its coarser size, but this is quite erroneous (see under notes below). I have not examined the Type as it is on loan to the Australian National Herbarium, Canberra. However, I have been able to establish the identity of *C. schistorhiza* from specimens determined by R. Carolin and J. West at the Western Australian Herbarium and from the illustration in the 'Flora of Central Australia' displaying both plant habit and seed. This species, although quite variable, is easy to recognize (see under notes below).

Perennial herb; root system consisting of a tap-root like tuber (sometimes appearing as a thickened root), the tuber often branched. *Plant* prostrate to decumbent, 30–140 mm tall × 40–300 mm wide, glabrous. *Basal leaves* fleshy, broadly spatulate, 15–700 mm × 3–25 mm at widest point. *Plant* with 4–22 stems, occasionally once branched below the inflorescence. Commonly 2–4 bract pairs per stem with a whorl of 3 bracts frequently occurring on the lowest node. *Stem bracts* spreading, ±scarious, triangular to broadly ovate, 3–7 mm long, apex sometimes recurved. *Inflorescence* a terminal solitary flower on an erect pedicel (11–36 mm) which may deflex moderately when in fruit. *Sepals* thin, normally light tan, greenish or reddish, orbicular, 7–11.5 mm long, sometimes with a relatively strong central nerve and several weaker nerves with some interconnecting reticulation, commonly spreading and crinkled when dry, often with a hyaline margin. *Petals* 5, normally bright to deep pink, 14–28 mm long, obovate to broadly obovate and often with a slightly crenulate and depressed apex. *Stamens* numerous; filaments free; anthers versatile. *Ovary* ellipsoid to subglobose. *Stigmata* 3, united onto a short style. *Capsule* ellipsoid to broadly ovoid, 8–11 mm × 3–5 mm; valves 3, splitting fully to base. *Seeds* black, roughly kidney-shaped, strongly verrucose and sometimes tuberculate, 0.5–0.8 mm long. (Figures 1G, 7)

Specimens examined. WESTERN AUSTRALIA: Flats S of mine, Paraburdoo, 24 Sep. 1979, *K.J. Atkins* 583 (PERTH 04221087); 19 km S of Wiluna, 13 Sep. 1978, *A.C. Beauglehole* & *E.G. Errey* ACB 59488 (PERTH 06189652); c. 283 km SE of Onslow on Nanaturra–Wittenoom road, 10 Aug. 1970, *R.C. Carolin* 7802 (PERTH 03332969); 14.5 km SE of Windidda homestead, Carnegie District, 6 Sep. 1973, *R.J. Chinnock* 818 (PERTH 01953451); Cue area, *s.dat.*, *J. Coxon* S 8 (PERTH 04100840); Mileura [Station NW of Cue], 24 Sep. 1969, *S.J.J. Davies s.n.* (PERTH 06040039); S of Rudall River, 10 Aug. 1992, *A.E. de Jong s.n.* (PERTH 03198073); Munarra Station, Meekatharra area, 14 July 2004, *F. & J. Hort* 2263 (PERTH 06870163); E of Dynamite Bore on Wongawol Station, 9 Sep. 2003, *K.F. Kenneally* & *D.J. Edinger* K 12666, E3863 (PERTH 06704271); On hills behind Newman Caravan Park, Newman, 11 Sep. 1995, *T.R. Lally* TRL735 (PERTH 04354214); Balfour Downs Station, Pilbara Region, 1 June 2004, *F. Obbens* & *B. Bromilow* FO31/04 (PERTH 06609732).

Distribution. *C. schistorhiza* is found throughout a wide area of the Eremaean Botanical Province from the Goldfields to the Pilbara. (Figure 8F)

Habitat. Usually grows in red sandy loam or clays often stony or rocky and probably does not occur on the lighter desert soils or near the coast. Can be found in a variety of arid shrub communities including mulga, gibber plains, open grassy flats and very open woodland.

Phenology. Flowers and fruits in June to September.

Conservation status. A species with a widespread distribution although it appears to be lightly collected across its range. However, it does not appear to be uncommon.

Etymology. From the Greek *schistos* – divided and *rhiza* – root. This is in reference to the divided or branched tubers of the Type specimen.

Notes. *Calandrinia schistorhiza* is usually a medium to larger sized plant and has large flowers regardless of the plant size making it the most recognizable species within the group (Figure 7). The length of the basal leaves is extremely variable; the blade always broadly spatulate and the petiole often strap-like. The tuber type somewhat resembles that of *C. crispisepala* although it is much larger (see Figures 2, 7). Additionally, the sepals of *C. schistorhiza* are somewhat crinkled like *C. crispisepala* and have sometimes a hyaline margin similar to *C. balonensis* Lindl. (sect. *Pseudodianthoideae*). As stated previously, Morrison considered *C. schistorhiza* to be closely related to *C. primuliflora*. It is easy to understand how he came to this conclusion because the two look superficially alike, however, on detailed inspection there are a number of clear differences. For instance, *C. schistorhiza* has an open flower with broadly obovate petals while *C. primuliflora* has a constricted floral throat with broadly suborbicular petals. Additionally, the stigmata of *C. schistorhiza* are united onto a style while those of *C. primuliflora* are free to base. The seed and tuber of *C. schistorhiza* and *C. primuliflora* are also very different. It is in fact these same characters that make *C. schistorhiza* appear to be more closely related to *C. crispisepala*, as outlined earlier.

The illustration of *C. schistorhiza* in the 'Flora of Central Australia' is a reasonable representation of the plants habit and seed. The illustration also portrays a flower in longitudinal section with the stigmata incorrectly appearing to be free to the base. As stated above, *C. schistorhiza* always has 3 stigmata united onto a short or moderate length style. The illustration of *C. schistorhiza* (i.e. Figure 7) displays a habit type somewhat different to that depicted in the 'Flora of Central Australia' and also shows some of the basal leaf variation and other details that are useful in identification of this species.

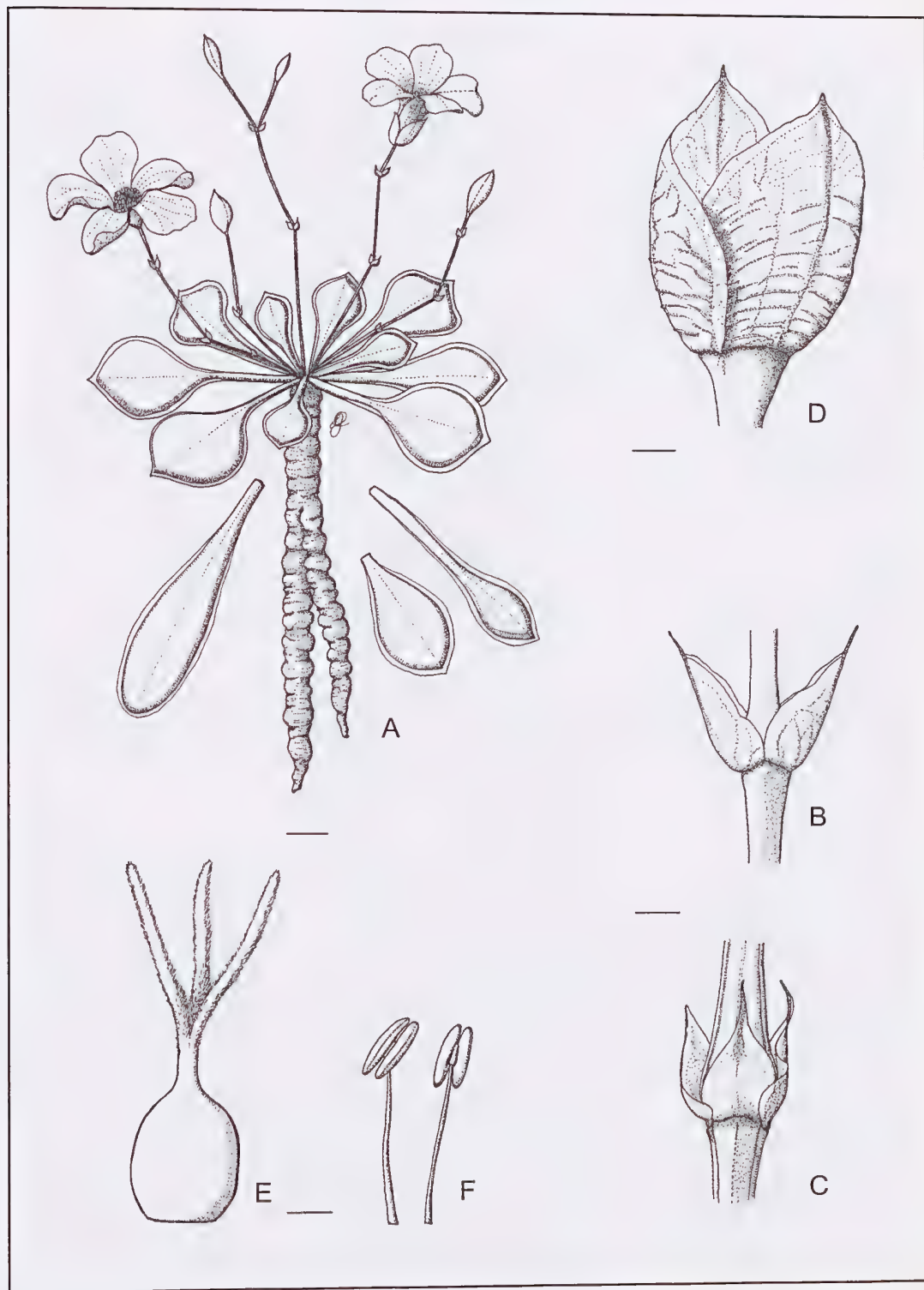


Figure 7. *Calandrinia schistorhiza*. A - plant habit displaying a tap-root like tuber (sometimes appearing as a thickened root); B - upper stem bract; C - lower stem bract; D - sepals; E - gynoecium; F - stamens. Scale bars: A = 10mm; B-D = 2mm; E-F = 1mm.

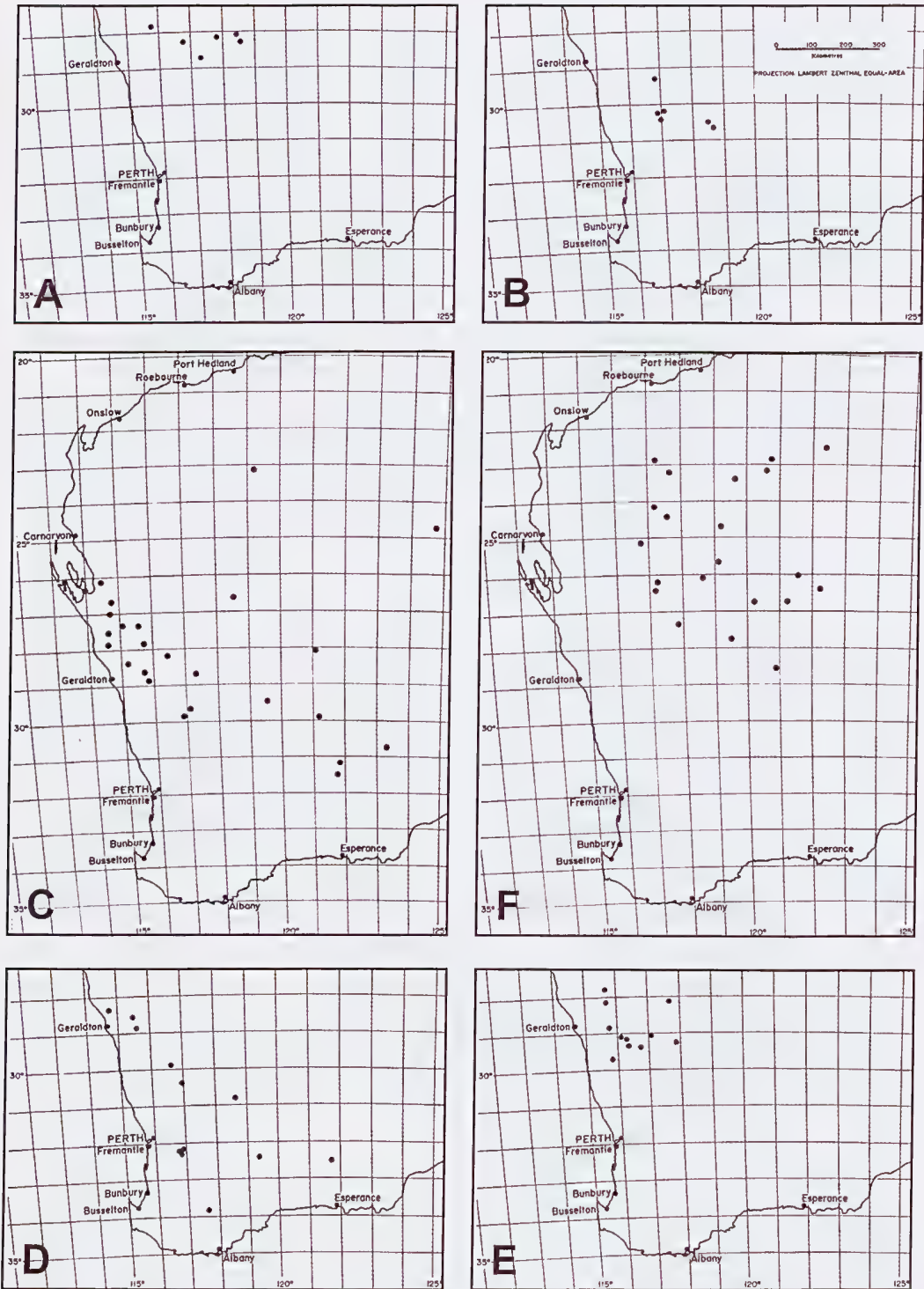


Figure 8. Species distributions. A – *Calandrinia crispisepala*; B – *Calandrinia kalanniensis*; C – *Calandrinia translucens*; D – *Calandrinia lehmannii*; E – *Calandrinia primuliflora*; F – *Calandrinia schistorhiza*.

Discussion

This review has highlighted many of the differences and similarities between members of *Calandrinia* section *Tuberosae* and should go some way towards alleviating past confusions and problems with identification. The review has found no radical deviations away from von Poellnitz's original section description although, as previously mentioned, I would add that section *Tuberosae* has 5-merous flowers and 3 stigmata which are either free to base or are united onto a style. One might also add to this description some of Syeda and Carolin's (1989) comments regarding seed structure and patterning.

However, I have concluded from this review that there appear to be two broad sub-groups within section *Tuberosae*. The first, with black strongly verrucose seeds and taproot-like tubers or appearing as a thickened root comprises *C. crispisepala* and *C. schistorhiza*. This sub-group also has crisped sepals and often has a whorl of 3 bracts at the lowest stem node. The second sub-group contains the remaining 4 species, all of which possess a narrow vertical root attached to a tuber or tubers. In this second sub-group the seed characters are somewhat similar in *C. kalanniensis*, *C. lehmannii* and *C. primuliflora* which have lighter coloured, moderately verrucose seeds, while *C. translucens* has light coloured, but smooth seeds. There appears to be some strong morphological evidence to suggest taxonomic ranking of the first sub-group, but there is less so for the second. Only a significant cladistic or genetic study would reveal whether or not these subgroups deserve formal recognition.

Acknowledgements

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A partial revision of the south-western Australian species of *Micromyrtus* (Myrtaceae: Chamelaucieae)

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Abstract

Rye, B.L. A partial revision of the south-western Australian species of *Micromyrtus* (Myrtaceae: Chamelaucieae). *Nuytsia* 16(1): 117–147 (2006). This partial revision of the genus *Micromyrtus* Benth., deals mainly with species that have a ten-ribbed hypanthium, but excludes the *M. racemosa* complex. All of the new species are endemic to the south-west of Western Australia. Eight taxa are named: *M. acuta* Rye, *M. chrysodema* Rye, *M. clavata* J.W. Green ex Rye, *M. elobata* subsp. *scopula* Rye, *M. placoides* Rye, *M. navicularis* Rye, *M. redita* Rye and *M. triptycha* Rye. A key is given for Western Australian members of the genus. *Micromyrtus* is compared with its close relative *Corynanthera* J.W. Green, and the morphological specialisations of both genera and their possible affinities to other genera in tribe Chamelaucieae are discussed. The compressed winged diaspore of *Corynanthera*, which has the peduncle fused to both the bracteoles and fruit, is of particular interest, and an illustration compares it with diaspores from five- and ten-ribbed species of *Micromyrtus*.

Introduction

A recent revision of the south-western Australian species of *Micromyrtus* Benth. (Myrtaceae) with a five-ribbed hypanthium (Rye 2002a) omitted one new species, which is described here. The current paper deals primarily with the ten-ribbed species of *Micromyrtus* and completes the coverage of the south-western taxa except for one difficult species complex comprised of *Micromyrtus racemosa* Benth. and its closest relatives. The *M. racemosa* complex will be treated in a later publication.

Just after the paper revising the five-ribbed species of *Micromyrtus* had gone to press, two specimens that had been misplaced for some time were rediscovered at PERTH. They represent a new species. Green (1980: 203) cited one of these specimens under his description of *Micromyrtus flaviflora* (F. Muell.) F. Muell. ex J.M. Black, although his determinavit dated 13 September 1978 bore the note “Unusually small leaves”, showing that he considered the material to be atypical. This specimen resulted in the erroneous locality of Wialki being given for *M. flaviflora* in the key presented in Rye (2002a). There was also a printing error in this portion of the key, with the ovule numbers for *M. flaviflora* placed on the wrong line of the key. Other new data relevant to the five-ribbed species described previously are also presented here.

While the primarily five-ribbed species of *Micromyrtus* are widely distributed on mainland Australia, all of the ten-ribbed taxa are restricted to the south-west of Western Australia, where they form the higher proportion of the taxa. One of the primarily ten-ribbed taxa, *Micromyrtus serrulata*, was newly described

in Green's (1980) treatment of the genus in arid and semi-arid regions, but none of the other ten-ribbed species has been included in any of the recent revisions and flora treatments of the genus. It should be noted that the ribbing of some species is obscure or variable so that strict categorisation of all taxa as either five- or ten-ribbed is not possible.

Molecular studies of members of tribe Chamelaucieae of the Myrtaceae by Lam *et al.* (2002) included two eastern Australian species of *Micromyrtus*. These species formed a strongly supported clade within the tribe but showed no obvious close relationship with other genera that were sampled. More extensive sampling of members of the tribe, particularly of *Micromyrtus* species, is presently being undertaken. Results published so far (Wilson *et al.* 2004) indicate two clades, one comprised of *Micromyrtus elobata* and the monotypic genus *Corynanthera* J.W. Green and the other containing all the other species of *Micromyrtus* sampled. The morphological specialisations of *Corynanthera* are examined here in relation to *Micromyrtus* species, and the possible affinities of these genera to other members of the Chamelaucieae are briefly discussed.

Methods

All measurements were from dry herbarium collections, with leaf and bracteole measurements taken from the largest of these structures on each specimen. The apex of the mature flower buds in *Micromyrtus* varies from hemispheric to conic, with the intermediate state referred to here as 'high-hemispheric'. Petal length and most other floral measurements were taken from well pressed mature flowers. Peduncle and style measurements were taken from mature flowers and from fruits. Fruit measurements include the adnate portions of the hypanthium and disc but do not include the length of the free portion of the hypanthium and the persistent sepals.

Conservation codes given here are as defined at the end of this *Nuytsia* issue. Botanical provinces are as defined by Beard (1980). Distributions were plotted on maps showing the interim biogeographic regions of Thackway & Cresswell (1995) and the following abbreviations are used here for these regions:

AW – Avon Wheatbelt	CAR – Carnarvon	COO – Coolgardie	ESP – Esperance Plains
GS – Geraldton Sandplain	MAL – Mallee	MUR – Murchison	YAL – Yalgoo

Comparison of *Micromyrtus* and *Corynanthera*

Micromyrtus and the monotypic *Corynanthera* appear on morphological grounds to form a single natural group in the Myrtaceae. The two genera are similar in their habit, inflorescence, flower shape, stamen number and arrangement, gynoecium and fruit characters. *Corynanthera* has two notable specialisations that distinguish it from *Micromyrtus*, these being its anther type and its dispersal unit. The highly modified anthers in *Corynanthera* have a long-stalked gland and highly fused thecae, with the anther dehiscing by a single central pore. Among the *Micromyrtus* species, members of the *M. triptycha* complex show the greatest similarity to *Corynanthera* in the degree of specialisation of their anthers, but not in other characters such as stamen insertion and bracteole persistence. It appears that their anther specialisation arose independently of the kind found in *Corynanthera*.

The diaspore of *Corynanthera* (Figure 1A) is a highly compressed and laterally winged structure that includes the bracteoles and peduncle and encloses a single very compressed seed c. 1.8 mm long. Each

lateral wing extends along the margin of the peduncle and the full length of the keel of the bracteole, usually becoming broadest towards the top. The compressed peduncle is fused both to the flower and the bracteoles so that the base of the diaspore cannot be separated into its component parts without tearing. This peculiar fusion is no doubt what led Green (1979: 371) to describe the flowers as sessile when in fact they have peduncles *c.* 0.5 mm long.

No diaspores of the type found in *Corynanthera* are known in other genera of the Chamelaucieae, although this is not the only genus known to have fusion of the peduncle and bracteoles. In many species of *Calytrix* Labill., the bracteoles are persistent and united to the extended summit of the peduncle to form a sleeve-like structure known as a cheiridium, which usually has the bracteoles connate as well (Craven 1987). The cheiridium is generally not part of the diaspore, but serves a protective function for the fruit until the diaspore is released. In contrast, in *Corynanthera* the peduncle and bracteoles are involved in the dispersal of the fruit as they form part of the diaspore.

Being highly compressed and very light, the diaspores of *Corynanthera* would be readily dispersed by strong winds, which may be a factor triggering their release from the plant. Certainly the inflorescences borne towards the ends of the very spindly stems in this species are well exposed to the wind.

In *Micromyrtus* the diaspore usually consists of just the flower minus its petals and stamens, although a few species have persistent petals. Compressed flowers and diaspores have arisen more than once in *Micromyrtus*. Four of the species described in an earlier paper (Rye 2002a), for example *M. uniovula* Rye (Figure 1F,G), have a very compressed 5-ribbed hypanthium with two abaxial sepals, two lateral sepals and one adaxial sepal, with all of the ribs opposite sepals.

A different kind of very compressed diaspore occurs in several of the species described in the current paper, such as *M. acuta*, which is illustrated in Figure 1D,E. These species either have a 10-ribbed hypanthium or a reduced number of ribs but always with at least some of them opposite petals. On one side of the flower they have a lateral rib directly opposite a petal and the other side they have either a lateral rib opposite a sepal or two semi-lateral ribs opposite a sepal and petal. *Corynanthera* is different again, having the upper part of the flower somewhat compressed as well as the base, with two large abaxial sepals and three small adaxial sepals.

Previous descriptions of the hypanthium ribbing in *Corynanthera* are somewhat inaccurate. According to the protologue, the hypanthium has five faint longitudinal ribs opposite the sepals, suggesting that the species might be closer to some of the 5-ribbed species of *Micromyrtus* than to the 10-ribbed species. Actually the hypanthium in *Corynanthera* has 4, 6 or 8 main ribs, the 8-ribbed version as illustrated in Figure 1B,C. The most prominent ribs are the two lateral ribs, the central abaxial rib (opposite the abaxial petal) and the central adaxial rib (opposite the central adaxial sepal), with a further two intermediate ribs often present on one or both surfaces. In Rye (2002a) the lateral ribs of *Corynanthera* were interpreted as being opposite sepals only. However, they seem to represent the amalgamation of two ribs that are only separated at the top where they terminate both with the lateral petals and the adjacent abaxial sepals. The total number of ribs could therefore be considered to be a maximum of ten if each of the lateral ribs were counted as two ribs. Evidence from the pattern of ribbing suggests that *Corynanthera* has greater affinities with the 10-ribbed than with the 5-ribbed species of *Micromyrtus*, supporting Green's (1979) assessment of the affinities of his new genus.

In the molecular data to date (Wilson *et al.* 2004) only *Micromyrtus elobata* falls in the same clade as *Corynanthera*. *Micromyrtus elobata* shows no obvious strong morphological similarities to single it out as being the only species closely related to *Corynanthera*, although it does have a 10-ribbed

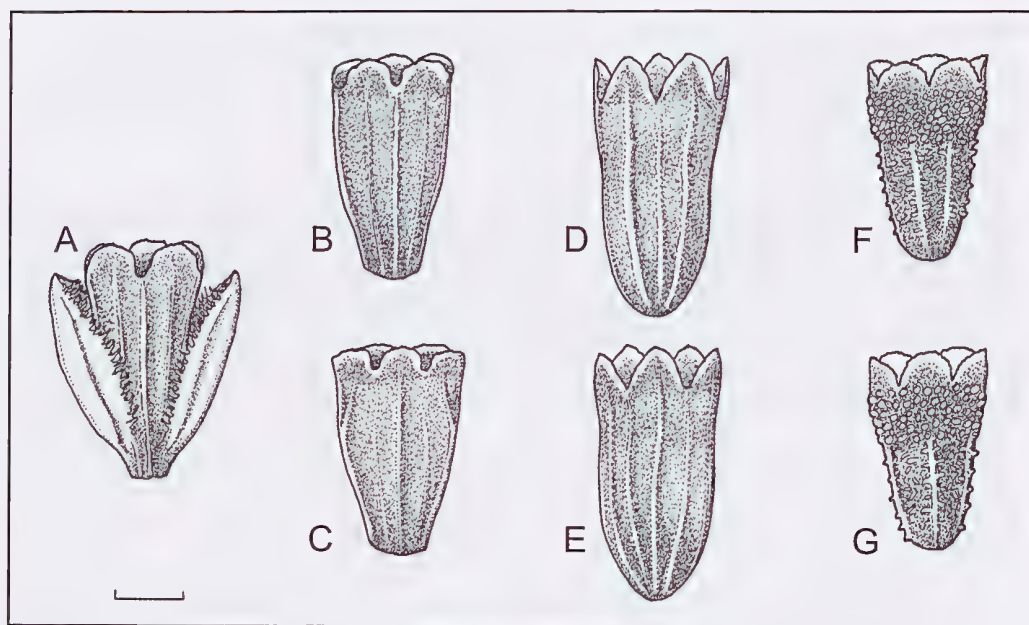


Figure 1. A–C. *Corynanthera flava*. A – whole diaspore; B – abaxial surface of young fruit torn from the peduncle; C – adaxial surface of young fruit. D, E. Diaspore of *Micromyrtus acuta*. D – abaxial surface; E – adaxial surface. F, G. Diaspore of *Micromyrtus uniovula*. F – abaxial surface; G – adaxial surface. Scale bars are 1 mm long. Drawn by Lorraine Cobb from E.A. Griffin 8206 (A–C), B.L. Rye 231018 & M.E. Trudgen (D, E) and R.J. Cranfield 7903 & P.J. Spencer (F, G).

hypanthium and a somewhat modified anther. Unpublished data using the nuclear ETS region now has resulted in a single clade for all of the *Micromyrtus* species, but unfortunately no sequence could be obtained for *Corynanthera*, probably because of primer incompatibility (Peter Wilson pers. comm.).

Interestingly, the known distributions of *Corynanthera* and *Micromyrtus* are parapatric (Rye 2002a: Figure 1A). *Micromyrtus rogerii* J.W. Green ex Rye has been collected just north and just south of the distribution of *Corynanthera flava* J.W. Green but not within its range, *M. uniovula* occurs just north of its range and *M. racemosa* extends along its eastern boundary.

Affinities of *Micromyrtus*

As noted in the previous section, *Micromyrtus* and *Corynanthera* have many similarities but differ in their anther morphology and a number of characters related to their diaspores. A further difference is that the style is more broadly based in *Corynanthera* than it is in *Micromyrtus*.

There is still no clear indication, either from the morphology or molecular data, which genera apart from *Corynanthera* show the greatest affinities to *Micromyrtus*. Bentham (1867) considered *Micromyrtus* to be closely allied to *Thryptomene sens. lat.* (including *Aluta* Rye & Trudgen), but it can be readily separated by the arrangement of its stamens, position of its ovules, and its generally very spindly habit. In *Micromyrtus*, pollen is released from slits that tend to meet at the base of the anther, whereas in *Thryptomene sens. lat.*, the slits (or more commonly the lines on which dehiscence by pores occurs) converge towards the summit of the anther.

Micromyrtus is not closely related to *Malleostemon* J.W. Green, a genus that is superficially similar in its stamen arrangement, uniloculate ovary and high placement of the placenta. As noted by Green (1983), the geniculate stamens and the tendency for the style base to be obliquely inserted into a slight depression indicate that *Malleostemon* has affinities with genera such as *Babingtonia* (Lindl.) Benth. and *Scholtzia* Schauer rather than with *Micromyrtus*, and this is confirmed by molecular data (e.g. Lam *et al.* 2002).

The strictly regular arrangement of stamens opposite both the sepals and petals, often in two distinct whorls, with the antipetalous whorl being retained when stamen number is reduced, is one of the main diagnostic characters of *Micromyrtus*. The closest approach to this strict arrangement of ten stamens is seen in some species with reniform seeds from several genera, such as the species that are currently known as *Rinzia carnosa* (S. Moore) Trudgen and *Baeckea clavifolia* S. Moore. The 10-staminate species of *Malleostemon*, such as *M. peltiger* (S. Moore) J.W. Green, have a more irregular arrangement of the stamens opposite the sepals and petals, suggesting a more recent development of this trait than that seen in *Micromyrtus* species.

No other suggestions based on morphology have been made in the literature regarding the affinities of *Micromyrtus*. Now that the over-emphasis on the unilocular ovary has been removed by expanding the limits of the tribe Chamelaucieae to include the subtribe Baeckeeinae (Wilson *et al.* 2005), detailed morphological comparisons of *Micromyrtus* with multi-locular genera are more likely to be undertaken. This may eventually lead to a better understanding of the affinities of the genus.

Generic description

Micromyrtus Benth. in G. Bentham & J.D. Hooker, *Gen. Pl.* 1: 700 (1865); *Thryptomenes* sect. *Micromyrtus* (Benth.) F. Muell., *Fragm. Phyt. Austral.* 8: 13 (1873).

Type: *Micromyrtus drummondii* Benth. *nom. superfl.* = *Micromyrtus obovata* (Turcz.) J.W. Green; lectotype, *fide* B.L. Rye, *Nuytsia* 15: 102 (2002a).

Description of the genus as given in Rye (2002a: 103) except for the following additions or modifications. *Shrubs* tending to be spindly and open, usually with very slender stems, glabrous or largely glabrous. *Leaves* concolorous or paler on adaxial surface. *Peduncles* slightly to distinctly dorsiventrally compressed. *Bracteoles* caducous to persistent. *Flowers* orientated with a sepal directly opposite the axis (i.e. adaxial) and a petal abaxial. *Hypanthium* 5–10-ribbed or 5-angled. *Anthers* distinctly 2-celled in most species but appearing 1- or 3-celled in a few taxa. *Ovary* with a small ovule-bearing cavity either close to the summit or nearer the middle (but never below the middle); placenta shortly above the middle to subterminal within the cavity. *Fruit* 1- or 2-seeded.

Size and distribution. Currently 45 named species are recognised in the genus, which is endemic to mainland Australia, occurring both in the arid zone and in moderately high rainfall zones (see Rye 2002a: Figure 1A). *Micromyrtus* has its greatest concentration of species in the south-west of Western Australia but is absent from the extreme south-west. A second concentration of species occurs in eastern Australia, particularly in the region encompassing southern Queensland and northern New South Wales.

Habit. *Micromyrtus* species tend to have a very spindly habit. Most plants are obviously single-stemmed at the base, with the main stem slender and its branches very slender. However, mature plants

may have several branches arising at, or just above, ground level (Figure 2B). Often the habit is very open (Figure 2E), although older plants of some taxa can become quite bushy (Figure 2A). Mechanical damage to the upper part of the plant, often seen in roadside plants after the verge has been graded, can lead to multiple stems from the base. Fires may also result in this kind of regeneration. The type specimen of *M. rogeri* is clearly fire-tolerant as it has very numerous very slender stems arising from a very thick base that has been blackened by fire. The lignotuber in *M. rogeri* is an above-ground structure and no examples are known of below-ground lignotubers in the genus. The fire tolerance of most species has not been recorded.

Inflorescence and floral characters. Peduncles are 1-flowered in all taxa but are regarded as being reductions from an axillary peduncle bearing more than one flower rather than being equivalent to axillary pedicels. The flowers are often recurved and the adnate part of the hypanthium is often somewhat to very dorsiventrally compressed. Three of the south-western species have the petals forming a cone with an acute apex to the flower buds, as shown in the photograph of *M. elobata* (Figure 2D). Other species have the bud apex hemispheric and broadly obtuse, as in *M. navicularis* (Figure 2F) or intermediate in shape with the apex somewhat raised and narrowly obtuse.

Fruit characters. The ovary is much longer than the ovules, with the remainder of the cell containing a loose spongy tissue, which breaks down or is displaced during the growth of the fertilised ovule or ovules. A solitary mature seed usually fills the entire cell at maturity, the hypanthium expanding outwards to accommodate the mature fruit but showing little or no elongation. Two-seeded fruits are common in *Micromyrtus rogeri* but very rare or unknown in other *Micromyrtus* species except for *M. clavata*, in which 2-seeded fruits are often present but are certainly not as numerous as 1-seeded fruits. In south-western species the seed is usually about twice or more than twice as long as wide, and the testa is a membranous, often loose, envelope that is shiny and coloured off-white to golden brown or reddish, with a minute reticulate pattern. Inside this envelope, the seed surface is dull white or off-white and fairly smooth.

The fruit is enclosed in the adnate portions of the hypanthium and disc and is capped by the free portion of the hypanthium and the persistent sepals. In all but one of the 10-ribbed species the petals close to an erect position in fruit and are shed before the fruit matures. *Micromyrtus sulphurea* is unusual in having persistent widely spreading petals, which presumably facilitate the dispersal of the nuts. In this respect it is similar to the five-ribbed species *M. imbricata* Benth.

Key to Western Australian taxa of *Micromyrtus*

1. Ovules 6–10.
 2. Hypanthium 5-angled, prominently rugose. Stamens 5.
 3. Peduncles 1.5–2.5 mm long. Hypanthium 2.3–3.6 mm long.
(Burnabinmah Station to central Australia.) ***M. flaviflora***
 3. Peduncles 0.6–1.1 mm long. Hypanthium 1.2–1.5 mm long.
(Wongan Hills to Wialki.) ***M. redita***
 2. Hypanthium 5-ribbed but otherwise fairly smooth. Stamens 10.
 4. Filaments filiform, less than 0.1 mm wide. Sepals with margin not recurved.
(East of Warburton.) ***M. helmsii***
 4. Filaments lorate, over 0.3 mm wide. Sepals with margin strongly recurved.
 5. Leaves more or less broadly elliptic, 1–2.5 mm long. Sepals with large fimbriate auricles obscuring the hypanthium.
(Gibson Desert to far west of South Australia.) ***M. fimbriosepala***

5. Leaves more or less narrowly oblong-elliptic, 2.5–4 mm long. Sepals with small denticulate auricles, the hypanthium clearly visible.
(Cundeelee to Rawlinson Range.) ***M. hymenonema***
1. Ovules 1 or 2.
6. Ovule 1.
 7. Stamens 5. Petals very narrowly clawed. (Norseman area.) ***M. papillosa***
 7. Stamens 10. Petals fairly broadly clawed or broad-based.
 8. Leaves oblong-elliptic. Adnate portion of hypanthium narrowed towards base, rounded on abaxial surface, with adaxial rib very prominent. (Three Springs area.) ***M. uniovula***
 8. Leaves obovate. Adnate portion of hypanthium the same width throughout, almost flat on abaxial surface, with adaxial rib not prominent. (Ninghan Station area.) ***M. ninghanensis***
6. Ovules 2.
9. Hypanthium pentagonal in TS and expanding to a broad summit (i.e. somewhat obconic), each angle with a prominent rib opposite a sepal.
10. Hypanthium ribs broad and rounded. Petals widely spreading and becoming reddish in fruit. (Ravensthorpe to Cape Arid National Park.) ***M. imbricata***
10. Hypanthium ribs narrow, sharply angled. Petals closing to a fairly erect position or spreading at base but incurved distally in fruit.
11. Hypanthium 1.5–2.5 mm long. Petals 1.9–2.4 mm long, widely spreading in fruit at least in basal half, the distal half sometimes curved inwards. (Mt Manning Range to Comet Vale to Coolgardie.) ***M. monotaxis***
11. Hypanthium 0.8–1.6 mm long. Petals 1.1–2 mm long, closing to a straight erect position in fruit.
12. Peduncles 0.5–1.5 mm long. Stamens 10. Style 0.35–0.8 mm long. (Wubin to Lake Grace.) ***M. obovata***
12. Peduncles 1.3–2 mm long. Stamens 5–10. Style 0.1–0.25 mm long. (Merredin to Coolgardie to Newdegate to Kumarl.) ***M. erichsenii***
9. Hypanthium terete or 5-angled to very compressed, if pentagonal in TS then with fairly straight sides (i.e. more cylindrical than obconic), scarcely ribbed to distinctly 10-ribbed.
13. Stamens 5.
 14. Hypanthium rugose distally and densely bearded below. Stamens c. 2.5 mm long. (Gibson Desert.) ***M. barbata***
 14. Hypanthium somewhat rugose-reticulate throughout. Stamens c. 0.5 mm long. (Leinster area.) ***M. chrysodema***
13. Stamens 10.
 15. Leaves densely and shortly fimbriate.
 16. Peduncles 0.8–1.3 mm long. Bracteoles deciduous. Hypanthium very compressed, with 2 abaxial, 1 adaxial and 2 lateral ribs. (Arrino area) ***M. rogeri***
 16. Peduncles 0.2–0.5 mm long. Bracteoles persistent. Hypanthium somewhat compressed, 10-ribbed. (Melita Station to near Karonie.) ***M. serrulata***
 15. Leaves entire or denticulate.
 17. Flower buds with apex conic, i.e. appearing acute from side view. Bracteoles usually persistent.
 18. Hypanthium with adnate portion somewhat compressed. Sepals reduced to a narrow ring.
 19. Leaves acute. (Salmon Gums to Fitzgerald River National Park to Israelite Bay.) ***M. elobata* subsp. *elobata***

19. Leaves with a subterminal protrusion that exceeds or equals the apex. (Kumarl to SW of Balladonia) **M. elobata** subsp. **scopula**
18. Hypanthium with adnate portion very compressed. Sepals small but distinct, 0.4–0.6 mm long.
20. Hypanthium scarcely swollen laterally in bud, 10-ribbed in flower. Sepals 0.4–0.5 × 0.5–0.8 mm. (Paynes Find area.) **M. acuta**
20. Hypanthium laterally swollen (compressed-urceolate) in bud, scarcely ribbed or with 5 ribs opposite the petals. Sepals 0.5–0.6 × 0.8–1 mm. (Tallering Peak to Cue.) **M. placoides**
17. Flower buds with apex hemispheric or high-hemispheric, i.e. broadly or narrowly obtuse. Bracteoles usually caducous or deciduous.
21. Anthers longer than the filaments; cells fused into a 3-lobed structure.
22. Leaves 0.5–0.7 mm wide, with one main row of obvious oil glands and sometimes a partial second row of glands. Hypanthium 1.5–2.3 mm long. (Ravensthorpe Range.) **M. navicularis**
22. Leaves 1–2.3 mm wide, with 2–4 main rows of oil glands, the glands sometimes inconspicuous. Hypanthium 1.9–3 mm long. (Maya to Newdegate area.) **M. triptycha**
21. Anthers shorter than or rarely as long as the filaments; cells together forming a 2- or 4-lobed structure but not closely fused.
23. Petals yellow, widely spreading in fruit. (Wooramel River to Wiluna to Paynes Find.) **M. sulphurea**
23. Petals white to yellow, closing erect in fruit and shed before fruit matures.
24. Hypanthium compressed or very compressed, with ribs usually not very obvious or the adaxial ones more obvious than the abaxial ones.
25. Hypanthium 2.5–3.5 mm long, compressed, with ribs not very obvious. Sepals 0.1–0.2 mm long, erect in fruit. (Rason Lake to Cundeelee area.) **M. stenocalyx**
25. Hypanthium 1.4–2.2 mm long, the adaxial ribs often more prominent than the abaxial ones. Sepals 0.25–0.5 mm long but strongly incurved in fruit and then appearing to be absent. (Ninghan Station to Leonora.) **M. clavata**
24. Hypanthium not very compressed, fairly prominently and equally 10-ribbed. (Kalbarri National Park to Diemal Station to Kondinin.) **M. racemosa** complex

Update to the previous revision

Field observations and new collections have provided extra data for some of the species previously described in Rye (2002a), particularly for *M. monotaxis* Rye and *M. obovata*, which together with their close relative *M. erichsenii* are referred to here as the *M. obovata* complex. These data are presented here.

All new species descriptions are presented in the following section of this paper. Three of the species described there, *Micromyrtus chrysodema*, *M. redita* and *M. stenocalyx*, are relevant to the earlier

revision of Rye (2002a). *M. chrysodema* and *M. redita* are new species that both appear to be related to *M. flaviflora*, the former being the rediscovered species mentioned in the introduction to the current paper and the latter an entirely new species collected for the first time in 2004.

Micromyrtus stenocalyx was included in the key to 5-ribbed taxa in Rye (2002a) but was not described then, as it had previously been treated by Green (1980). However, this species is variable in its ribbing, which is weak and sometimes not present at all, and may be 5- or 10-ribbed. It appears to have greater affinities to some of the 10-ribbed taxa than the 5-ribbed taxa and so is probably more relevant to the current paper.

New data for the *Micromyrtus obovata* complex

Examination of new (*K. Honczar* C23, *L.W. Sage* & *F. Hort* 2042) and existing fruiting material of *Micromyrtus monotaxis* has revealed that the sepals and petals are widely spreading (previously described as being fairly erect in fruit) although the petals of some specimens are curved inwards part way along their length. The sepal and petal orientation of this species is a very useful means of distinguishing it from its two closest relatives *M. obovata* and *M. erichsenii*, both of which have the petals and sepals erect in fruit.

Despite the large amount of herbarium material previously available for *M. obovata*, mature seeds were rare or absent, suggesting a very low seed set in this species. However, freshly collected material from one specimen (*B.L. Rye* 231088 & *M.E. Trudgen*) contained a reasonable quantity of seeds indicating that seed set is not always as poor as previously reported. The seeds were $1.6\text{--}1.7 \times c. 0.9$ mm, larger than previously recorded and of a similar size to those of the new material of *M. monotaxis*, which were found to be $1.5\text{--}1.7 \times c. 0.9$ mm. The seeds of all three species can probably be distinguished, however, as those of *M. erichsenii* are smaller, $1.1\text{--}1.4 \times 0.5\text{--}0.8$ mm, and those of *M. monotaxis* are distinctly shaped, having the summit more convex and the base narrower than in the other two species.

New data for *Micromyrtus rogeri* and *M. uniovula*

A newly collected specimen of *Micromyrtus rogeri* (*M.E. Trudgen* 22126) has mature compressed fruits *c.* 2.1 mm long and 1.8 mm wide, which together with the attached free hypanthium and sepals are *c.* 3.5 mm long. Three dissected fruits each contained two erect seeds, one on each side of a central furrow. The seeds were not very compressed and were *c.* 1.5 mm long and *c.* 0.6 mm wide. This is the only species of *Micromyrtus* known to produce such a high proportion of 2-seeded fruits.

Previously, the habit of *Micromyrtus uniovula* was recorded on herbarium specimens as 0.2–0.4 m high. Two more recent collections give the height as up to 0.6 m. A large population, which extends along a laterite ridge for *c.* 200 m, was sampled in the current study (*B.L. Rye* 239019 & *M.E. Trudgen*) and found to be comprised of spindly, mostly open shrubs, up to 1.3 m high. A few low and widely spreading plants of *c.* 0.4 m were also present.

Micromyrtus uniovula appears to have very low seed set, with no mature seeds having been observed in this species. Despite three recent collections (*S.J. Patrick* 4040, 4055 & 4486) of the species having been made well into the fruiting period, all of the mature fruits examined lacked a seed.

Species and subspecies descriptions

Micromyrtus acuta Rye, *sp. nov.*

Bracteolae persistentes. Alabastri apex conicus. Hypanthium c. 2.5 mm longum, parte inferiore dorsiventraliter compressum, costis 10, 5 abaxialibus, 3 adaxialibus et 2 lateralibus. Sepala aliquantum erecta, petalis multo breviora, integra. Petala alba, in fructu decidua. Stamina 10, obdiplostemonia, brevissima. Ovula 2.

Typus: 20 km south-west of Paynes Find, Western Australia, 2 September 1977, *J.W. Green* 4651 (*holo*: PERTH 01751433; *iso*: CANB, K, MEL).

Shrub erect, 0.8–2 m high, single-stemmed at base or multi-branched from ground level or just above. *Leaves* antrorse, moderately densely arranged distally on the branchlets. *Petioles* 0.3–0.4 mm long. *Leaf blades* oblong-obovate in outline, 1.5–1.8 × 0.6–0.8 mm, very thick, broadly obtuse, entire; lower surface rather flat along midvein and with steep sides, rugose, with 4–6 prominent oil glands less than 0.1 mm diam. in each longitudinal row; upper surface flat or shallowly convex. *Racemes* mostly extending for 3–8 nodes, the flowers antrorse to almost patent; peduncles 0.7–1.1 mm long. *Bracteoles* persistent, herbaceous with narrow more or less scarious margins, narrowly ovate, 1.1–1.4 mm long, acute, entire. *Buds* with apex conic. *Flowers* tending to be recurved, 4–5 mm diam.; hypanthium very dorsiventrally compressed in adnate part, the free portion more open, narrowly urceolate in outline, c. 2.5 mm long, 0.8–1.3 mm wide; adnate portion slightly to distinctly 10-ribbed, tending to have 3 abaxial ribs, 2 lateral ribs and 5 adaxial ribs but sometimes with 2 semi-lateral ribs on one side, not prominently patterned between the ribs, more or less flat or slightly concave on abaxial surface, slightly convex to flat on adaxial surface; free portion 0.5–0.7 mm long, becoming uniformly lined with 10 longitudinal indentations. *Sepals* fairly erect in flower and fruit, rather scarious, broadly to depressed ovate, 0.4–0.5 mm long, 0.5–0.8 mm wide, white, almost acute to broadly obtuse, entire. *Petals* widely spreading in flower, deciduous in fruit, more or less elliptic to ovate, 1.5–2 mm long, fairly narrow or broad at base, white, acute, entire. *Stamens* 10, the 5 antipetalous ones inserted at summit of disc and with the anther at the throat, the 5 antisealous ones inserted distinctly lower in the tube and included; filament 0.3–0.35 mm long. *Anthers* 0.3–0.35 mm long; slits very oblique; gland narrower than the full anther (i.e. exceeded laterally by the cells), with 2 or 4 lateral lobes distinctly smaller than the apical portion. *Ovary* with 2 ovules in a more or less central cavity. *Style* c. 0.35 mm long. *Fruit* not seen at maturity. (Figure 2A–C)

Other specimens examined. WESTERN AUSTRALIA: 16 km SW of Paynes Find, 23 Aug. 1974, *A.C. Beaglehole* 49161 (PERTH); 20 km SW of Paynes Find, 24 June 1995, *S.J. Patrick* 2292 (PERTH); Whitewells Station, on low granites SW of homestead, 6 Oct. 2003, *S.J. Patrick* 4849A (PERTH); Whitewells Station, 7.4 km E of western boundary fence, SW of homestead, 10 Oct. 2003, *S.J. Patrick* 4975 (PERTH); Lake Monger Lookout, off Rabbit Proof Fence Rd, not far N of Wanarra Rd, 29°29.530'S, 116°37.206'E, 13 Oct. 2003, *B.L. Rye* 231018 & *M.E. Trudgen* (PERTH); 14 km W of Warriedar Homestead, 26 Sep. 1986, *Paul G. Wilson* 12262 (PERTH).

Distribution and habitat. Occurs on both sides of the border between the South West Botanical Province and Eremaean Botanical Province, extending from west of Lake Monger east to near Paynes Find: YAL. The habitat at the Lake Monger Lookout was of outcropping partially laterised granite and grey-tan silty fine to coarse sand, with *Allocasuarina-Acacia* high open shrubland over *Micromyrtus* (to 1.7 m high) open shrubland over *Cryptandra-Calytrix* low open shrubland over *Lepidosperma*-

Austrodanthonia-Lomandra very open grass-sedge-herbland. No other detailed habitat descriptions are available but at all localities the species is recorded with granite and/or laterite. (Figure 3A)

Phenology and insect associations. Flowers July to October. Two uncommon kinds of scale-forming insect larvae are present. Very compressed scales with a white long-ciliate border, and longer thicker ones of a more advanced stage, are attached at the base of the inner surface of many leaves on the type specimen. More elongated glabrous brown scales are attached, mostly to the inside base of the leaf blades just above the petiole, on *S.J. Patrick* 4975.

Conservation status. Conservation Codes for Western Australian Flora: Priority One. Known from at least four localities with a range c. 90 km long.

Etymology. From the Latin *acutus*—sharp-pointed or acute, referring to the acute apex to the flower buds and often acute apex also on the individual sepals.

Notes. Although it does not occur in the Cue area, this taxon has been known for some time by the manuscript name *Micromyrtus cuensis* J.W. Green ms. That was because it was previously considered conspecific with a very closely related taxon from the Cue area, described below as *Micromyrtus placoides*. Since Green annotated a specimen (*J.W. Green* 4651) from the Paynes Find area as the type of *M. cuensis* ms., it seemed best not to use that name for the new taxon that actually occurs in the Cue area. These two taxa could possibly be treated as subspecies but show significant floral differences as well as a geographic separation of about 200 km. See notes under *M. placoides*.

Micromyrtus chrysodema* Rye, *sp. nov.

Bracteolae deciduae vel persistentes. Alabastri apex hemisphericus. Hypanthium c. 2.5 mm longum, 5-angulatum, parte inferiore 5-costatum, parte superiore 10-costatum. Sepala erecta, petalis multo breviora, integra. Petala alba. Stamina 5, filamentis antheris longioribus. Ovula 2.

Typus: near Leinster [precise locality withheld], Western Australia, 11 March 2004, *P.G. Armstrong* POA33 (*holo:* PERTH 07214340; *iso:* NSW).

Shrub densely branched, height unknown. *Leaves* closely antrorse to fairly widely spreading, densely arranged on the smaller branchlets. *Petioles* 0.2–0.3 mm long. *Leaf blades* mostly narrowly oblong to obovate in outline, c. 1.6 × 0.6 mm, c. 0.35 mm thick towards apex, broadly obtuse, mucronulate and sometimes with a few minute teeth around the apex; lower surface shallowly convex towards base with a flat inconspicuous midvein, becoming thicker and with a raised obvious midvein towards apex, each side of the midvein with an irregular row of 4–8 main glands less than 0.1 mm diam.; upper surface almost flat. *Racemes* mostly extending for 1–4 nodes, the flowers usually widely antrorse; peduncles 1.2–1.6 mm long. *Bracteoles* deciduous or persistent, rather scarious, c. 1.3 mm long, acute, entire. *Buds* with apex hemispheric. *Flowers* probably 3.5–4 mm diam.; hypanthium with adnate portion 5-angled, 5-ribbed towards the base but 10-ribbed at summit, the longer ribs opposite the sepals, c. 2.5 mm long, c. 1.1 mm wide at midpoint, c. 1.3 mm wide at summit, free in distal c. 0.4 mm, 5-angled to 10-ribbed, the degree of ribbing varied, the ribs opposite the sepals usually more obvious or longer than those opposite the petals. *Sepals* erect in flower, scarious, depressed ovate, c. 0.35 mm long, c. 0.5 mm or more wide, broadly obtuse, entire. *Petals* with claw erect and remainder probably widely spreading in flower, almost circular or depressed obovate, c. 1.5 mm long, white, broadly clawed, broadly obtuse, apparently entire but crisped.

Stamens 5; filament c. 0.4 mm long. *Anthers* c. 0.3 mm long; slits oblique; gland with its lateral lobes similar in size to the apical part of the gland. *Ovary* with 2 ovules in a terminal cavity. *Style* not seen at maturity. *Fruit* not seen.

Distribution and habitat. Collected from near Leinster in the Eremaean Botanical Province of Western Australia: MUR. Recorded on red sandplain with *Eucalyptus gongylocarpa* emergent from scrub dominated by *Acacia aneura* over low scrub and *Triodia*. (Figure 3B)

Phenology. The type material collected in March was mostly in young bud but had a few flowers open.

Conservation status. Conservation Codes for Western Australian Flora: Priority One. Known from a single population with about 30 plants spread sparsely within a 1 km radius. The species occurs well inland in a poorly known area so there is a reasonable chance that further populations would be found if the region were surveyed.

Etymology. From the Greek *chrysos* – gold and *demos* – district, referring to the occurrence of this species in the goldfields area of Western Australia.

Affinities. This recently discovered and still very poorly known species appears to be very distinctive. *Micromyrtus chrysodema* is one of six Western Australian taxa with five stamens, and molecular data (Peter Wilson pers. comm.) suggest that its closest affinities are with one of the other 5-staminate species, *M. flaviflora*. It is readily distinguished from that species by its fewer ovules and the lack of prominent rugose patterning on its hypanthium.

Micromyrtus clavata* J.W. Green ex Rye, *sp. nov.

Bracteolae caducae vel deciduae. Alabastri apex hemisphericus. Hypanthium c. 1.5–2 mm longum, ex parte inferiore dorsiventraliter compressum, costis adaxialibus magis numerosis et magis prominentibus quam costis abaxialibus. Sepala in fructu incurva, petalis multo breviora, integra. Petala alba, in fructu decidua. Stamina 10, obdiplostemonia, brevia. Ovula 2.

Typus: 30 miles [48 km] south of Paynes Find on Great Northern Highway, Western Australia, 27 August 1967, J.V. Blockley 492 (*holo:* PERTH 01630776).

Shrubs erect, 0.3–1.8 m high, up to at least 1 m diam., single-stemmed at base and often multi-branched from ground level of just above. *Leaves* antrorse to almost appressed, fairly densely arranged on the smaller branchlets. *Petioles* 0.2–0.3 mm long. *Leafblades* mostly obovate in outline, 1.3–2 × 0.7–1 mm, thick, broadly obtuse, entire; lower surface flat or with an indentation along midvein and the fairly steep sides with 4–6 prominent glands up to 0.1 mm diam.; upper surface shallowly concave to almost flat. *Racemes* mostly extending for 1–7 nodes, the flowers usually widely antrorse; peduncles 0.5–1.1 mm long. *Bracteoles* caducous or deciduous, rather scarious, 0.5–0.7 mm long, red-green, acute, entire. *Buds* with apex hemispheric. *Flowers* 3–3.5 mm diam.; hypanthium with adnate portion dorsiventrally compressed, 1.4–2.2 mm long, 0.7–0.9 mm wide at midpoint, 1.2–1.4 mm wide at summit, free in distal 0.25–0.5 mm, usually 10-ribbed but sometimes with only some of the ribs obvious, tending to have 5 abaxial ribs, 2 lateral ribs and 3 adaxial ribs (but sometimes appearing to have 5 ribs on each surface and no ribs strictly lateral, or to have 3 lateral ribs), with the ribs on adaxial surface often more prominent than the abaxial ones, somewhat concave on abaxial surface. *Sepals* fairly erect in flower, strongly incurved in fruit, scarious, depressed ovate, 0.25–0.5 mm long, 0.4–0.6 mm wide, obtuse, entire. *Petals* with claw erect and remainder widely spreading in flower, deciduous in fruit, almost circular or depressed obovate, 1.3–

1.4 mm long, white, rather narrowly clawed, broadly obtuse, entire. *Stamens* 10, the antipetalous ones inserted on summit of disc, the antisepalous ones inserted near the middle of the free tube; filament 0.4–0.5 mm long. *Anthers* c. 0.3 mm long; slits very oblique (c. half way between transverse and longitudinal); gland 3-lobed, with its very prominent lateral lobes similar in size to the apical part of the gland. *Ovary* with 2 ovules in a terminal cavity. *Style* 0.2–0.4 mm long. *Fruit* somewhat compressed to almost terete, 1.6–2.3 mm long, 1–1.2 mm wide, 1- or 2-seeded; hypanthium often without obvious ribs. *Seeds* more or less wedge-shaped, convex except where adjacent to a second seed, the adjacent surface tending to be flat, $1.4-2 \times 0.7-0.8$ mm; testa pale golden brown, with a slight pattern of indentations corresponding with oil glands on the fruit casing.

Other specimens examined. WESTERN AUSTRALIA (all PERTH): Hospital Rocks, 30 miles [48 km] W of Riverina, 11 Sep. 1973, *J.S. Beard* 6522; 16 km SW of Paynes Find, 23 Aug. 1974, *A.C. Beauglehole* 49163; 50 miles [80 km] SW of Paynes Find, 8 Sep. 1938, *W.E. Blackall* 3850; Fields Find, near Thundelarra Homestead, 25 May 1971, *W. Carr s.n.*; Yendang Rock, Walling Rock Station, 9 Sep. 1988, *R.J. Cranfield* 7249; Hospital Rock, 7 Sep. 1989, *R.J. Cranfield* 7758; 3 km SW of Niagara Dam, 6 July 1995, *R.J. Cranfield* 9866; 53 km N of Paynes Find on the Mount Magnet road, 16 Oct. 1981, *L.A. Craven* 7136; 221 mile peg on Paynes Find–Mount Magnet road [83 km N of Paynes Find], 19 July 1966, *A.R. Fairall* 1784; 281 mile peg on Paynes Find–Mount Magnet road [27 km N of Paynes Find], 20 July 1966, *A.R. Fairall* 1798; 51 km SW of Paynes Find, near Mt Singleton, 2 Sep. 1977, *J.W. Green* 4653; NW slope of unnamed hill immediately to the NW of Yandhanoo Hill, Ninghan Station, 2 Aug. 2000, *M. Hislop* 2082; 63 miles [101 km] NE of Wubin, 24 Aug. 1965, *K.R. Newbey* 2024; 20 km SW of Paynes Find, 22 Aug. 2001, *S.J. Patrick* 3966; summit of hill c. 1.5 km SE of Six Mile Well, Ninghan Station, 23 Aug. 2001, *S.J. Patrick* 3974; c. 1.5 km W of Warro Well along fenceline and c. 100 m S of fence, Ninghan Station, 24 Aug. 2001, *S.J. Patrick* 3982; W of Paynes Find, E side of road around gravel extraction area, 10 Aug. 2002, *S.J. Patrick* 4227; Great Northern Highway, 2 km N of Ninghan turnoff, 29 Aug. 2003, *S.J. Patrick* 4709 & *A Crawford*; 41.3 km N of Paynes Find, 29 Aug. 2003, *S.J. Patrick* 4711; 66 miles [106 km] N of Wubin, 30 July 1974, *E. Wittwer* 1252.

Distribution and habitat. Eremaean mainly: AW, COO, MUR, YAL. Extends from Ninghan Station (west of Paynes Find) east to Melita Station (near Leonora). Commonly recorded in red or brown sandy soils, often on granite outcrops or on laterite. The vegetation has rarely been recorded, but *Acacia* species were noted as the dominant shrubs at two localities. (Figure 3C)

Phenology and insect associations. Flowers June to September. Fruits recorded August to October. Fruits and seeds were measured from *L.A. Craven* 7136 and *R.J. Cranfield* 7758. White wax scales are attached to the leaves of a number of specimens, for example *A.C. Beauglehole* 49163. Long-ciliate scales, similar to those found on *Micromyrtus acuta*, occur on the inner surface of some leaves of *S.J. Patrick* 4227. The insect larvae are protected within these scales by their position, sandwiched between the leaves and stems with only the tangled white cilia visible.

Etymology. From the Latin *clavatus* - club, in reference to the leaf shape.

Notes. *Micromyrtus clavata* appears to produce more two-seeded fruits than all other south-western species except for *M. rogeri*, and its one-seeded fruits often show evidence of a second seed having partially developed. This taxon is distinguished from all other 10-ribbed species by its strongly incurved sepals in fruit. It has been confused with *M. racemosa* but is readily distinguished by its more compressed hypanthium with the adaxial ribs tending to be more prominent than the abaxial ones. It also has a more prominently lobed anther, a characteristic it shares with *M. placoides* and *M. acuta*, which tend to have a more strongly compressed hypanthium. *M. clavata* differs from those two species in having the adaxial surface of the hypanthium strongly multi-ribbed. *Micromyrtus clavata* has apparently been found in

close proximity with *M. acuta*, as both are recorded from 16 km south-west of Paynes Find (*A.C. Beauglehole* 49161, 49163). Evidence of a close relationship between these two species is the occurrence on both of very unusual scales with a border of long tangled white cilia. Insect larvae of this kind have not been found on any other species.

Micromyrtus elobata (F. Muell.) Benth., Fl. Austral. 3, 64 (1867). – *Thryptomene elobata* F. Muell., Fragm. Phyt. Austral. 4: 63 (1864). *Type*: sandy places inland of Israelite Bay, [Western Australia], *G. Maxwell* (*lecto*: MEL 71324, *fide* Rye (2002b: 153)). *Other collections*: Israelite Bay, [Western Australia], *G. Maxwell* (*lectopara*: MEL 71325).

Shrubs usually erect, 0.1–1.5 m high, up to c. 1 m diam., single-stemmed at the base. *Leaves* closely antrorse to almost patent, fairly densely arranged on the smaller branchlets. *Petioles* 0.3–0.8 mm long. *Leafblades* very narrowly to broadly obovate, usually narrowly obovate or obovate, 1–6 × 0.8–1.5 mm, often prominently keeled towards apex, entire or denticulate; lower surface convex and sometimes fairly steep-sided, sometimes with an indentation along midvein, with 2–10 prominent glands less than 0.2 mm diam.; upper surface concave to almost flat. *Racemes* mostly extending for up to 16 nodes, the flowers antrorse or widely antrorse; peduncles 0.3–1.1 mm long. *Bracteoles* often persistent in young fruit but usually shed before fruit matures, with a herbaceous keel and broad scarious sides, narrowly ovate to broadly obovate, 1.5–2.8 mm long, acute or acuminate, entire but sometimes with the erect or incurved keel produced into a subterminal point. *Anthopodium* often long. *Buds* with apex conic. *Flowers* 3–5 mm diam.; hypanthium somewhat compressed on adnate portion, prominently 10-ribbed. *Sepals* apparently absent in flower, reduced to a narrow scarious margin less than 0.2 mm long (although summit of hypanthium tends to become lobed in fruit and apparently forms distinct largely herbaceous sepals), entire. *Petals* with claw erect and remainder widely spreading in flower, deciduous in fruit, broadly obovate, 1.5–2.5 mm long, white, somewhat folded, acute, entire. *Stamens* 10, the antipetalous ones inserted on summit of disc, the antisepalous ones inserted near the middle of the free tube and included or reaching throat; filament 0.2–0.25 mm long. *Anthers* 0.2–0.25 mm long; slits very oblique (almost transverse); gland with apical portion much larger than the 2 lateral lobes. *Ovary* with 2 ovules in a cavity just above the middle. *Style* 0.2–0.4 mm long. *Fruit* almost terete, 1.2–2.3 mm long, 0.7–1 mm wide, 1-seeded; hypanthium longer than the fruit, prominently 10-ribbed, often with a reticulate pattern of glands or slightly transverse ridges between the ribs. *Seed* obovoid-conic (top truncate), 1.4–1.5 × c. 0.6 mm; testa golden brown with a deep reddish tinge.

Phenology and insect associations. Flowers and fruits recorded all year. Galls in the form of stem swellings (e.g. on *G.F. Craig* 266B) or terminal swellings (e.g. on *K.R. Newbey* 7318) are sometimes present. Scale-forming insects seem to be uncommon, but black sculptured scales are present on the leaves of *A.S. George* 11287 and white wax scales on *M.A. Burgman* 1104 & *S. McNee*.

Notes. This is an extremely variable taxon with two main variants, which are described here as subspecies as they are largely geographically separated, although they possibly intergrade.

a. *Micromyrtus elobata* (F. Muell.) Benth. subsp. *elobata*

Illustration. Blackall & Grieve (1980: 43).

Shrubs usually erect and 0.3–1.5 m high, up to c. 1 m diam. *Leaves* closely antrorse to almost patent, fairly densely arranged on the smaller branchlets. *Petioles* 0.3–0.8 mm long. *Leafblades* very narrowly

to broadly obovate, usually narrowly obovate or obovate, 1.5–6 mm long, 0.8–1.5 mm wide, always wider than thick, acute or almost acute, slightly mucronulate to distinctly pointed, the point often recurved and up to 0.25 mm long, prominently keeled towards apex but keel not exceeding apex, with a narrow hyaline margin that is slightly to fairly prominently denticulate laterally (especially where the leaf is broadest), with teeth often c. 0.1 mm long, or rarely with hyaline margin more or less absent or entire; lower surface convex and sometimes fairly steep-sided, sometimes with an indentation along midvein, with 4–10 prominent glands less than 0.2 mm diam.; upper surface concave to almost flat. *Racemes* mostly extending for 3–16 nodes; peduncles 0.3–1.1 mm long. *Bracteoles* somewhat to much shorter than the mature flower and fruit, narrowly ovate to broadly obovate, 1.5–2.8 mm long, acute or acuminate, the apical point up to 0.35 mm long. *Anthopodium* 0.3–1.5 mm long, sometimes greatly expanded at the base. *Flowers* 3–5 mm diam.; hypanthium 1.7–2.3 mm long above the anthopodium. *Petals* 1.5–2.5 mm long. *Fruit* 1.5–2.3 mm long; hypanthium 1.6–2.5 mm long above the anthopodium. *Seed* obovoid-conic (top truncate), 1.4–1.8 × 0.6–0.7 mm; testa golden brown with a deep reddish tinge. (Figure 2D)

Selected specimens examined (of large-leaved variant). WESTERN AUSTRALIA: 60 km SW of Israelite Bay ruins, opposite Mt Baring, 7 Jan. 1979, *B. Barnsley* 375 (PERTH); 6 miles [10 km] NW of Gibson, 8 July 1968, *P.J. Cole* 409 (PERTH); 30 km NE of Esperance on Dempster Rd, 26 Nov. 1985, *D.B. Foreman* 1225 (PERTH); Lort River, Dec. 1940, *C.A. Gardner s.n.* (PERTH); NW of Whoogarup Range, Fitzgerald River National Park, 17 Mar. 1972, *A.S. George* 11287 (PERTH); 10 km W of Munglinup, 21 Sep. 1977, *J.W. Green* 4669 (PERTH); Young River, *G. Maxwell* or *A. Oldfield* (K); 7 km WNW of Quoin Head, 1 Nov. 1975, *K.R. Newbey* 4905 (PERTH); 10.5 km NW of Gibson Soak Hotel on Coolgardie–Esperance highway, 8 Aug. 2003, *Peter G. Wilson* 1633 & *G.M. Towler* (PERTH).

Selected specimens examined (of small-leaved variant). WESTERN AUSTRALIA: 15 km S of Salmon Gums on the Esperance road, 21 Oct. 1981, *L.A. Craven* 7214 (PERTH); junction of Lagoon and Kendall Rds, c. 7 km E of Scadden, 10 Nov. 1992, *A.M. Lyne* 1115, *L.A. Craven* & *F. Zich* (PERTH); 72 km W of Salmon Gums, 11 Nov. 1979, *K.R. Newbey* 6475 (PERTH); 9 km E of Scaddan on Norwood Rd, 26 May 1982, *P. van der Moezel* 11 (PERTH); Truslove Reserve, 7 km SE of Truslove, 15 Jan. 1981, *Paul G. Wilson* 11825a (PERTH).

Distribution and habitat. Occurs in the south-eastern portion of the South West Botanical Province: ESP, MAL. Extends along the south coast from Fitzgerald River National Park east to near Israelite Bay and inland to Salmon Gums. Occurs in deep sand and a variety of other sandy soils often with clay also present, commonly on low-lying plains or on dunes, and also fairly commonly recorded in lateritic habitats. The vegetation at some locations is dominated by mallees (*Eucalyptus*). (Figure 3A)

Notes. A very variable taxon. Specimens that have very small leaves tend to be from the more inland localities and overlap in range slightly with the inland subspecies, while the largest-leaved specimens are from the most mesic situations including the far south-west of the species range. Correlated to some degree with leaf length are floral characters, including anthopodium and hypanthium length and degree of protrusion of the flowers from the bracteoles.

At one extreme are short-leaved specimens (for example those cited separately above), with a short anthopodium, short broad hypanthium and broad relatively persistent bracteoles extending more or less to the summit of the hypanthium. At the other extreme, specimens such as *A.S. George* 11287 have flowers with a long anthopodium and a long narrow hypanthium distinctly exceeding narrow bracteoles, which tend to be lost before the fruiting stage. There appears to be a full range of intermediates; no discontinuities could be found that would justify the description of additional infraspecific taxa.

b. *Micromyrtus elobata* subsp. *scopula* Rye, subsp. nov.

A subspecies typica foliis, pedunculis et floribus plerumque minoribus, carina folii projecto subterminali ornata differt.

Typus: 13.9 km along Kau Rock Rd from Coolinup Rd, north-east of Esperance, Western Australia, 21 October 1997, *Peter G. Wilson* 1420 (*holo*: PERTH05715814; *iso*: NSW).

Shrubs usually erect, 0.1–0.4(1) m high, up to c. 0.5 m diam. *Leaves* widely antrorse, crowded on the smaller branchlets. *Petioles* 0.15–0.3 mm long. *Leafblades* narrowly to broadly obovate, 1–2.5 mm long up to c. 1 mm wide, sometimes about as thick as wide, with a subterminal protrusion of the prominent keel equalling or usually exceeding the apex, usually entire; lower surface fairly steep-sided, with an indentation along midvein, with 2–5 main glands less than 0.2 mm diam. and some smaller glands on each side; upper surface concave to almost flat. *Racemes* mostly extending for 1–5 nodes, the flowers antrorse, often subsessile at first; peduncles 0.3–0.5 mm long, broad and compressed. *Bracteoles* broadly ovate, 1.8–2.3 mm long, acute or acuminate, entire. *Anthopodium* 0.05–0.3 mm long. *Flowers* 3–3.5 mm diam.; hypanthium 1.3–1.6 mm long above the anthopodium. *Petals* 1.5–1.7 mm long. *Fruit* c. 1.3 mm long; hypanthium 1.4–2 mm long, prominently 10-ribbed, with patterning between the ribs. *Seed* not measured.

Other specimens examined. WESTERN AUSTRALIA: no locality, 28 Mar. 1983, *M.A. Burgman* 1084 & *S. McNee* (PERTH); 121.5 km S of Balladonia, 33°15'52"S, 123°00'03"E, 19 Aug. 1995, *R.J. Cranfield* 10155 (PERTH); Kumarl, May 1938, *L.A. Horbury* 49 (PERTH); SW margin of Dundas Nature Reserve, 14 Dec. 1990, *G.J. Keighery* 12587 (PERTH); 38 km NNE of Mt Ridley, 8 Mar. 1980, *K.R. Newbey* 6689 (PERTH); 30 km W of Ponier Rock, 80 km SW of Balladonia Motel, 14 Sep. 1980, *K.R. Newbey* 7318 (PERTH); 12 km S of Mt Buraminy, c. 110 km NE of Esperance, 9 Nov. 1980, *K.R. Newbey* 7997 (PERTH).

Distribution and habitat. Occurs in the far south-east of the South West Botanical Province: ESP, MAL. Extends from Kumarl east to c. 80 km SW of Balladonia and south-east to Kau Rock Rd. Occurs in deep aeolian sand. The vegetation, where recorded, is dominated by mallees (*Eucalyptus*). (Figure 3B)

Phenology. Flowers recorded from August to October. Mature fruits and seeds measured from *R.J. Cranfield* 10595.

Conservation status. Conservation Codes for Western Australian Flora: Priority Three. Known from Dundas Nature Reserve and about eight other localities in a poorly known region. The taxon is likely to be more common than the few available collections suggest.

Etymology. From the Latin *scopulus* – pointed or projecting rock, referring to the shape of the projection on the leaves.

Notes. This taxon is similar to the inland variant of subsp. *elobata* but usually can be readily identified by its unusual leaves. However, one somewhat intermediate specimen is *M. Hislop* 1253 collected from south-west of Mt Ney.

In addition to its odd leaves, subsp. *scopula* has a very short peduncle and anthopodium, short broad hypanthium and broad bracteoles extending beyond the summit of the hypanthium.

Micromyrtus navicularis* Rye, *sp. nov.

Micromyrtus triptychi affinis sed foliis angustioribus magis navicularibus et distributione magis meridionali et orientali differt.

Typus: north side of Mt Short, 14 km north-north-west of Ravensthorpe, Western Australia, 8 August 1968, *P.G. Wilson* 6936 (*holo*: PERTH 01630849; *iso*: CANB *n.v.*, K *n.v.*, PERTH 01630830).

Shrub erect, 0.5–1.6 m high, single-stemmed at the base, with long leaves on short spreading lower branches almost patent and forming 4 dense rows, far exceeded by tall spindly stems bearing shorter and usually more appressed leaves. *Petioles* 0.3–0.5 mm long. *Leafblades* very narrowly obovate from side view, very concave adaxially, with a rounded somewhat incurved apex, 3–4.5 × 0.5–0.7 mm, entire or minutely denticulate towards the apex; lower surface very convex, with usually 8–14 prominent glands up to 0.15 mm diam. in each row, with 1 main row on each side of the midrib, sometimes with a partial second row; upper surface very concave, the margins at middle of leaf incurved towards one another. *Racemes* mostly extending for 6–20 nodes, present on both the lower lateral branchlets and the upper more erect ones; peduncles 1–2 mm long. *Bracteoles* caducous or deciduous, rather scarious, usually very narrowly oblong, folded to a more or less linear shape, 1.3–1.8 mm long, pale lime green to yellowish brown, entire, the apex usually strongly incurved but sometimes acute. *Buds* with apex hemispheric. *Flowers* 3–4 mm diam.; hypanthium with adnate portion dorsiventrally compressed, 1.6–2.3 mm long, 0.4–0.6 mm wide at midpoint, 0.8–1.2 mm wide at summit, free in distal 0.4–0.6 mm, 10-ribbed, usually not very clearly patterned between the ribs. *Sepals* erect in flower and fruit, somewhat scarious, depressed ovate or almost semicircular, 0.2–0.4 mm long, 0.35–0.5 mm wide, broadly obtuse, more or less entire. *Petals* with claw erect and remainder widely spreading in flower, deciduous in fruit, obovate, 1.3–1.8 mm long, white inside, sometimes turning partially deep pink outside, broadly obtuse, more or less entire, with some prominent glands on outer surface. *Stamens* 10, the antipetalous ones inserted on summit of disc, the antisepalous ones inserted near the middle of the free tube; filament 0.1–0.2 mm long. *Anthers* 0.3–0.4 mm long, with the cells forming a rounded-triangular to almost globular structure divided by slits into 3 more or less equal-sized parts; slits very oblique or more or less transverse; gland erect, very broad (projecting laterally beyond the cells), with 2 lateral lobes smaller than the apical portion. *Ovary* with 2 ovules in cavity in upper half but distinctly below the summit of ovary cell. *Style* c. 0.4 mm long. *Fruit* not compressed, 1.8–2.2 mm long, 0.7–0.8 mm wide, 1-seeded; hypanthium often becoming distinctly rugose and grey but sometimes darker and more brownish and smoother, with less obvious ribs when fully expanded. *Seed* narrowly obovoid-conic, 1.4–1.7 × 0.6–0.7 mm; testa medium golden-brown to dark red-brown. (Figure 2E, F)

Selected specimens examined. WESTERN AUSTRALIA: 1 km E of Mt Desmond, 9 Jan. 1979, *B. Barnsley* 452 (PERTH); 5 km E of Eldverton Rd, Ravensthorpe Range, 2 Apr. 1998, *M. Bennett* 99 (PERTH); right turn 10.8 km from Ravensthorpe on Esperance road, and walk S over ridge then ESE on bulldozed track, 24 Apr. 1999, *M. Bennett* 466 (PERTH); northern foothills of Mt Short, 20 Sep. 1977, *J.W. Green* 4668 (PERTH); lower slopes of Mt Short, 21 Sep. 1977, *E.N.S. Jackson* 3433 (PERTH); on Mt Short Rd, 1.0 km E of King Rd, and 2.65 km E of Newdegate–Ravensthorpe road, 33°27'26.9"S, 119°59'36.6"E, 8 Dec. 2003, *B.L. Rye* 231204 (PERTH) & 231205 (MEL, PERTH); old gravel pit, 3–4 km up Eldverton Rd from Esperance road, c. 12 km E of Ravensthorpe, 2 Aug. 1998, *E. Tink* 244 (PERTH); Mt Desmond, 18 Nov. 1976, *E. Wittwer* 1886 (PERTH).

Distribution and habitat. Restricted to the range of hills near Ravensthorpe: ESP. Occurs on the slopes of lateritic hills, sometimes also with granite present, the soil usually sandy with gravel or lateritic pebbles, the dominant species often mallees. (Figure 3C)

Phenology. Flowers recorded from July to January and also in April and May. Mature fruits and seeds measured from *E.M. Bennett* 2399 and *B.L. Rye* 231204, 231205.

Conservation status. Conservation Codes for Western Australian Flora: Priority Three. Very localised but probably fairly secure in the Ravensthorpe Range.

Etymology. From the Latin *navicularis* – boat-shaped, referring to the leaves. This is of similar meaning to the unpublished epithet of *carinata* that had previously been chosen for this taxon, a name that cannot be used as it has already been published for an eastern Australian species of *Micromyrtus*.

Affinities. This is one of four closely related but geographically distinct taxa that are referred to here as the *Micromyrtus triptycha* complex (see notes under *M. triptycha*). *Micromyrtus navicularis* is distinguished by its very narrow leaves, with the glands are commonly in only one row on each side of the leaf, whereas other members of the *M. triptycha* complex have several main rows of oil glands, and *M. navicularis* has the shortest hypanthium, down to 1.5 mm long, in the complex. It also appears to have the greatest dimorphism of its leaves, which are larger and more obviously 4-ranked on lower lateral branches than on the upper more erect branches, both of which produce flowers.

Notes. Previously known by two manuscript names. For a long time this species was housed at PERTH as *Micromyrtus racemosa* var. *carinata* J.W. Green ms., a name which was also used for some northern specimens in the *M. triptycha* complex. In 2002 the four geographically separated members of the *M. triptycha* complex were all treated informally as subspecies, with the name *Micromyrtus triptycha* subsp. *carinata* Rye ms. being applied to *M. navicularis*. However, this taxon appeared to be more distinctive than the others in its morphology and so is now distinguished as a distinct species.

Boat-shaped leaves occur to varying degrees in all members of the *Micromyrtus triptycha* complex, with the incurved margins varying from slightly divergent through erect to convergent in the lower half of the leaf, although the distal part often tends to be broader because the margins are more divergent there. *M. navicularis* has this characteristic particularly well developed, with its leaf margins erect to convergent.

***Micromyrtus placoides* Rye, sp. nov.**

Micromyrto acuto optime affinis sed floribus grandioribus, hypanthio latiore et minus distincte costato in ambitu urceolato, glandula supra antheram multi-lobata differt.

Typus: 1.8 miles [2.9 km] along road to Tallering Peak from main track, Western Australia, 14 September 1978, *M.E. Trudgen* 2229 (*holo:* PERTH 02418312; *iso:* AD, CANB, K, MEL, all *n.v.*).

Shrub 0.5–2.3 m high, up to at least 1 m wide, sometimes widely spreading with several stems or branches from the base. *Leaves* antrorse, moderately densely arranged distally on the branchlets. *Petioles* c. 0.3 mm long. *Leafblades* oblong-obovate to almost circular in outline, 1.3–2.2 × 0.8–1.3 mm, thick, broadly obtuse, glabrous; lower surface strongly convex or flattened along the midvein and with steep sides, with 5–9 prominent glands up to c. 0.1 mm diam. in each longitudinal row; upper surface flat. *Buds* with apex conic or nearly so. *Racemes* mostly extending for 4–7 nodes, the flowers antrorse to almost patent; peduncles 0.4–0.8 mm long. *Bracteoles* persistent, herbaceous and often with narrow more or

less scarious margins, ovate, 1.4–2 mm long, acute, entire, with prominent glands. *Flowers* tending to be recurved, 5–5.5 mm diam.; hypanthium with adnate portion very dorsiventrally compressed, the free portion more open, urceolate in outline and with the abaxial surface concave and adaxial surface convex, c. 3.3 mm long, c. 2 mm wide, free in distal 0.8–1 mm, scarcely ribbed or with 5 definite ribs opposite the petals (but central abaxial rib compressed for most of its length), with a fine reticulate pattern. *Sepals* fairly erect in flower and fruit, rather scarious, depressed ovate, 0.5–0.6 mm long, 0.8–1 mm wide, green to deep red-brown with a white margin, usually broadly obtuse, entire. *Petals* widely spreading in flower, deciduous in fruit, broadly obovate, c. 2 mm long, white, becoming broadly obtuse, entire. *Stamens* 10, the 5 antipetalous ones inserted at summit of disc and slightly exserted from the throat with a filament c. 0.35 mm long, the 5 antisepalous ones inserted distinctly lower in the free tube (almost half way down) but the latter still almost reaching the throat with a filament c. 0.5 long, all borne well above the style. *Anthers* c. 0.35 mm long; slits very oblique; gland very broad (extending laterally beyond the cells) and compact, multi-lobed, with up to 8 main lateral lobes of similar size or at least 4 main lobes and a number of smaller ones. *Ovary* with 2 ovules in an almost central cavity (slightly above centre). *Style* c. 0.5 mm long. *Fruit* not seen at maturity.

Other specimens examined. WESTERN AUSTRALIA: Cue, July 1926, C.A. Gardner s.n. (PERTH); top of middle gorge at Tallerang, Mullewa, 14 Apr. 2003, J. Docherty 225 (PERTH); Mt Narryer, c. 1 km NNW of main peak, 26 Aug. 1996, A.S. George 17273 (NSW, PERTH); below W side of Mt Narryer, 8 Aug. 1997, A.S. George 17335 (PERTH); Weld Range, slopes below Telecom tower, 3 Aug. 1995, S.J. Patrick 2387 & A. Brown (PERTH).

Distribution and habitat. Occurs in the Eremaean Botanical Province, in a similar habitat to *M. acuta* but possibly also on granite, extending from Mt Narryer in the north to near Tallerang Peak in the south-west and Cue in the south-east: MUR, YAL. (Figure 3A)

Phenology and insect associations. Flowers July to September. Translucent brown scales occur on the leaves of several specimens, including J. Docherty 225.

Conservation status. Conservation Codes for Western Australian Flora: Priority One. This species is known from scattered collections over a distance of c. 230 km. Since it occurs in a relatively remote and poorly collected region, *M. placoides* is likely to be more common than the few current collections suggest.

Etymology. From the Greek *plako* plate and *-oides* like, referring to the highly compressed, plate-like adnate portion of the hypanthium

Notes. Previously known by the informal geographic name *Micromyrtus* sp. Murchison (M.E. Trudgen 2229). This species is very closely related to *M. acuta*, the most significant difference between them being in the hypanthium, which is broader and distinctly extended laterally beyond the free portion of the hypanthium in *M. placoides* so as to have an urceolate shape in outline in the flower buds as well as in the mature flowers. In *M. placoides* the hypanthium is also more strongly convex/concave and has a more reticulate rather than ribbed patterning on the adaxial and abaxial surfaces.

Another difference is that the anther gland is broader and has more numerous lobes than in *M. acuta*. As far as can be determined from the few available collections of the two taxa, *M. placoides* also has larger flowers, with a longer hypanthium, larger more obtuse sepals, and longer stamens and style. It also tends to have more herbaceous and more prominently glandular bracteoles.

Micromyrtus redita* Rye, *sp. nov.

Micromyrtus flaviflora affinis sed foliis maturibus crassioribus, floribus et pedunculi minoribus differt.

Typus: Wongan Hills, Western Australia, date unknown [possibly collected in late September 1983], P. Roberts 244 (*holo*: PERTH 06254705).

Shrub densely branched, height unknown. *Leaves* antrorse to appressed, mainly on the lateral branchlets. *Petioles* c. 0.2 mm long. *Leafblades* narrowly oblong-elliptic to elliptic-obovate, 1.2–2.4 × c. 0.6 mm, broadly obtuse, entire; lower surface irregularly convex, often somewhat ridged towards apex and more flattened towards the base, with 2–6 prominent glands less than 0.2 mm diam. in a longitudinal row on each side of midvein; upper surface slightly concave to slightly convex, often with a longitudinal furrow down the centre. *Racemes* mostly extending for several nodes, the flowers widely antrorse to patent; peduncles 0.6–1.1 mm long. *Bracteoles* caducous or deciduous, not seen. *Flowers* c. 3 mm diam.; hypanthium slightly expanded abaxially and slightly compressed adaxially, 5-angled, 1.2–1.5 mm long, narrowed at base, c. 0.8 mm wide at midpoint, c. 1.4 mm wide at summit, free in distal c. 0.3 mm, somewhat 5-angled, rugosely patterned throughout. *Sepals* 5, erect in flower and fruit, slightly more scarious than the petals, depressed ovate, 0.4–0.5 mm long, 0.8–0.9 mm wide, reddish, very broadly obtuse, entire or minutely denticulate-laciniate. *Petals* 5, widely spreading in flower, then becoming erect, broadly or very broadly obovate, 1.3–1.5 mm long, distinctly clawed at base, white or pink-tinged, broadly obtuse, entire. *Stamens* 5, equal; filament c. 0.4 mm long. *Anthers* c. 0.3 mm long; slits somewhat oblique; gland globular. *Ovary* with 6–8 ovules in a more or less terminal cavity. *Style* c. 0.5 mm long. *Fruit* not seen at maturity, not compressed; hypanthium 5-angled, rugose.

Other specimen examined. WESTERN AUSTRALIA: Wialki, *s. dat.* [collected prior to 1978], F.H. Uther Baker (PERTH).

Distribution and habitat. Collected from Wongan Hills and Wialki in the South West Botanical Province of Western Australia. It is not clear whether the locality Wongan Hills refers to the town by that name or to the range of hills north of the town. No habitat information has been recorded on either of the specimens. (Figure 3B)

Phenology and insect associations. Flowering time unknown but one specimen may have been collected in late September, as some collections of other species by P. Roberts were made at that time in Wongan Hills. The specimen from Wialki has a sculptured black scale on one of its leaves.

Conservation status. Conservation Codes for Western Australian Flora: Priority One. Known only from two undated collections with vague localities. The known range of the taxon is in a largely cleared region of the wheatbelt. This, together with the paucity of collections, suggests that the taxon is very rare and could possibly be extinct. A survey of the region for *Micromyrtus redita* is urgently needed.

Etymology. From the Latin *reditus* – returned, referring to the fact that the specimens of this taxon were once lost.

Affinities. *Micromyrtus redita* is closely related to *M. flaviflora*, which differs in its longer peduncles, larger flowers, more glaucous and flattened leaves with usually more numerous oil glands, and usually

more prominently rugose hypanthium. Although *M. flaviflora* tends to have longer stamens, its style is of about the same length.

The two species are allopatric, with the new species restricted to the South West Botanical Province whereas *M. flaviflora* is widespread in the arid zone, extending from Burnabinmah Station in the Eremaean Botanical Province of Western Australia eastwards into south-western Northern Territory and the far north-west of South Australia. There is a disjunction of c. 200 km between the known ranges of the two taxa, as well as a considerable distance (c. 135 km) between the two known localities of the new species.

Notes. Recently housed under the informal name *Micromyrtus* sp. Avon (*P. Roberts* 244). This species is very poorly known, as its habit, habitat, flowering time, mature fruit and seed are unknown, and its localities are not precisely given.

As noted by Green (1980), *Micromyrtus flaviflora* is a very variable species, showing a number of changes in its morphology from west to east over its wide range. Two main variants can be distinguished, the typical one in the east of the range and an atypical western variant that was once regarded as the distinct species *M. trachycalyx* F. Muell. Possibly these two taxa should be recognised formally at the subspecific level, but they appear to intergrade too fully for this to be feasible.

The typical eastern specimens of *M. flaviflora* differ from the new species in their yellow petals and denticulate to fimbriate margins to the leaves and petals, but have a similar leaf shape. The atypical variant occurs in the region closest to the range of *M. redita* and tends to be similar to the new species in its flower colour and entire leaves but differs in the more obovate shape of its leaves.

Micromyrtus serrulata J.W. Green, *Nuytsia* 3: 199–201 (1980). *Type*: 32 km east of Karonie, Trans-Australia Railway, Western Australia, 9 November 1963, *A.S. George* 5951 (*holo*: PERTH 01631322; *iso*: PERTH 01631330).

Illustration. Green (1980: Figures 113–120).

Shrub 0.4–1.5 m high, erect or somewhat spreading. *Leaves* widely antrorse to appressed, rather densely arranged distally on the branchlets. *Petioles* 0.3–0.4 mm long. *Leaf blades* narrowly to broadly obovate, 1.8–3.3 × 0.7–1.5 mm, broadly obtuse, ciliolate, the cilia less than 0.1 mm long; lower surface angled-convex, glandular all over, with 7–9 usually very prominent glands up to c. 0.1 mm diam. in each main longitudinal row; upper surface shallowly concave, often somewhat paler than lower surface. *Racemes* mostly extending for 1–7 nodes, the flowers antrorse or widely antrorse; peduncles 0.2–0.5 mm long. *Bracteoles* persistent, with a green herbaceous keel and wide scarious margins, more or less elliptic, 2–3 mm long, narrowly obtuse or almost acute, denticulate. *Buds* with apex hemispheric. *Flowers* 4–6 mm diam., with several small processes < 0.1 mm long opposite the petals; hypanthium narrowly conic but with adnate portion somewhat compressed, 1.7–2.2 mm long, c. 0.5 mm wide at midpoint, 1.3–2 mm wide at summit, free and quite widely spreading in distal 0.5–0.7 mm, prominently 10-ribbed. *Sepals* widely spreading in flower and more erect in fruit, somewhat scarious, depressed ovate, 0.7–1.3 mm long, 1.4–2 mm wide, minutely denticulate. *Petals* with claw erect and remainder widely spreading in flower, closing erect in fruit, possibly sometimes deciduous, broadly obovate, 1.5–2.4 mm long, white, broadly obtuse, more or less entire. *Stamens* 10, the antipetalous ones inserted on summit of disc and antisepalous ones distinctly lower (somewhat above middle of free tube); filament 0.6–0.9 mm long. *Anthers* c. 0.35 mm long; slits very oblique (often closer to transverse than longitudinal); gland large, somewhat 3-lobed and

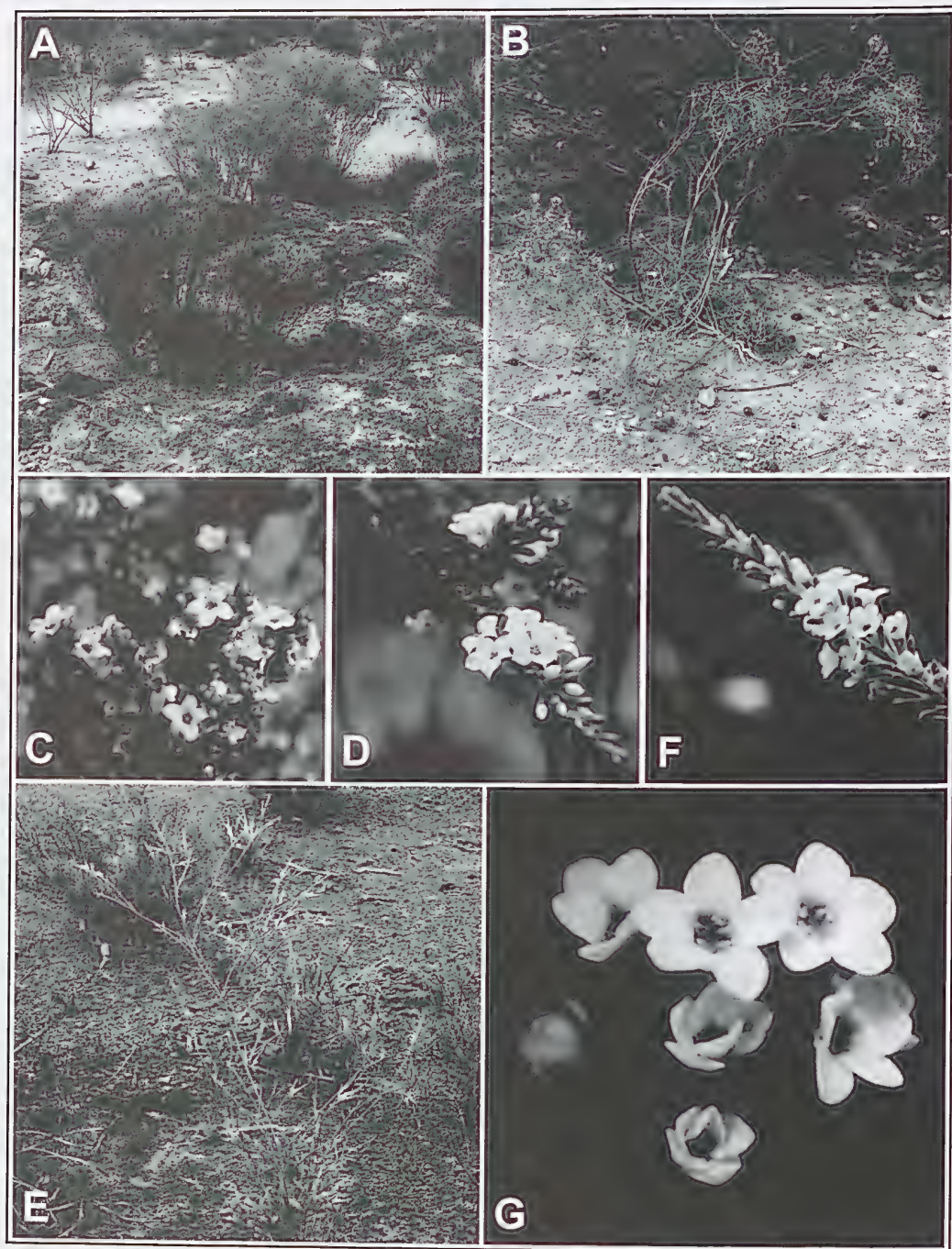


Figure 2. Photographs of *Micromyrtus* species. A–C. *M. acuta*, voucher B.L. Rye 231018 & M.E. Trudgen. A, B – habit, C – flowers; D – *M. elobata* subsp. *elobata*, flowering stem, voucher B.L. Rye 231226; E, F. *M. navicularis*, voucher B.L. Rye 231205. E – habit, F – flowering stem; G – flowers of northern variant of *M. triptycha* complex, voucher B.L. Rye 239105 & M.E. Trudgen.

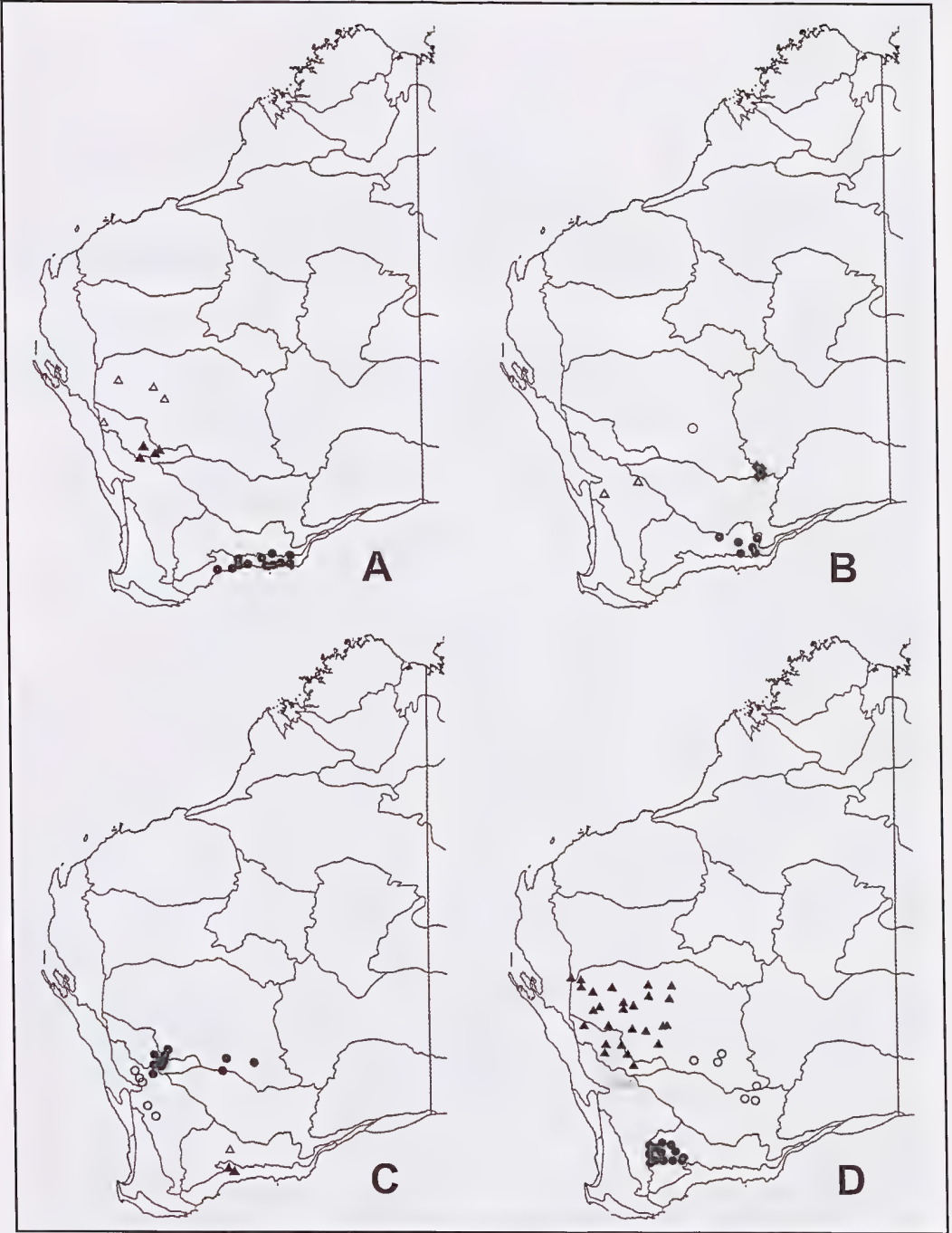


Figure 3. Distribution maps. A – *Micromyrtus acuta* (▲), *M. elobata* subsp. *elobata* (●) and *M. placoides* (△); B – *Micromyrtus chrysodema* (○), *M. elobata* subsp. *scopula* (●), *M. stenocalyx* (◆) and *M. redita* (△); C – *Micromyrtus clavata* (●), *M. navicularis* (▲), northern variant of *M. triptycha* complex (○) and Ironcaps variant of *M. triptycha* complex (△); D – *M. serrulata* (○), *M. sulphurea* (▲) and *M. triptycha* (●).

tuberculate-glandular at base, with elongated apical portion protruding inwards beyond the cells. *Ovary* with 2 ovules in a cavity above the middle but distinctly below the summit. *Style* 0.6–1 mm long. *Fruit* not seen at maturity.

Other specimens examined. WESTERN AUSTRALIA: Niagara Dam Nature Reserve, 5 Sep. 1990, A. Chapman & D. McMillan 90-32 (PERTH); Cardunia Rocks Nature Reserve, 24 Mar. 1992, A. Chapman 6/92 (PERTH); Wedge Melita Station, 13 June 1988, R.J. Cranfield 6979 (PERTH); 1.6 km SE of Alexandra Bore, Jeedamya Station, 16 June 1988, R.J. Cranfield 7021 (PERTH); 15 km W of Niagara Dam, 6 July 1995, R.J. Cranfield 9859 (PERTH); Cardunia Rock, 11 Aug. 1981, K.R. Newbey 8484 (PERTH); Site 57, Mavis Rock, 42 km W of Queen Victoria Spring, Queen Victoria Spring Nature Reserve, 26 July 1992, D.J. Pearson 2132 (PERTH); Nippon highway, 76.7 km W of Argus Corner, c. 0.7 km E of Kirgella Rocks, 5 Aug. 2003, Peter G. Wilson 1619 & G.M. Towler (PERTH).

Distribution and habitat. Eremaean Botanical Province: COO, MUR. Extends from Melita Station south-east to near Karonie. Recorded mainly from brownish or reddish sandy and clayey soil over granite, in mixed *Acacia* shrublands, also with *Eucalyptus petraea* recorded at one locality. (Figure 3D)

Phenology and insect associations. Flowers recorded June to November. Scale-forming insects are present on the leaves of many specimens. R.J. Cranfield 7021 has two kinds of scales, sculptured black scales with a very narrow white margin and white wax scales.

Conservation status. Conservation Codes for Western Australian Flora: Priority Three. Known from about seven localities, including three nature reserves, over an area extending c. 300 km.

Notes. Green (1980) described *Micromyrtus serrulata* from the type collection, which was the only one known at that time. While there are now at least seven additional collections, good fruiting material is still needed for this species. From some young and very old fruits that are present, it appears that the petals are more persistent than in most species of *Micromyrtus* but this needs confirmation. *M. serrulata* is one of the few south-western species with distinctly ciliolate leaves, and it has larger sepals than the other taxa except for one unnamed member of the *M. racemosa* complex.

Micromyrtus stenocalyx (F. Muell.) J.W. Green, *Nuytsia* 3: 201 (1980). –*Thryptomene stenocalyx* F. Muell., *Fragm. Phyt. Austral.* 10, 23–24 (1876). *Type:* ad scaturigines victoriae [Victoria Springs, Western Australia], J. Young (*holo:* MEL 70798 *n.v.*).

Illustrations. Blackall & Grieve (1980: 46) [as *Thryptomene stenocalyx*]; Green (1980: Figures 121–128).

Shrub 0.3–1.5 m high, often straggling or widely spreading. *Leaves* widely antrorse to appressed, rather densely arranged distally on the branchlets. *Petioles* 0.3–0.4 mm long. *Leaf blades* obovate or broadly obovate in outline, 1.3–3 × 0.8–1.3 mm, very thick, broadly obtuse, entire, with margins sometimes forming a narrow projecting rim; lower surface varying from steeply-sided and sometimes indented along midvein to smooth and strongly convex, with 3–5 usually very prominent glands up to c. 0.2 mm diam. in each longitudinal row; upper surface almost flat or somewhat convex on margin but deeply depressed along centre-base. *Racemes* mostly extending for 2–12 nodes, the flowers antrorse or widely antrorse, becoming patent in fruit; peduncles 0.6–1.4 mm long. *Bracteoles* caducous, rather herbaceous, narrowly ovate, 1–1.5 mm long, often reddish, acute, entire, with prominent glands. *Buds* with apex hemispheric.

Flowers 2.5–3 mm diam.; hypanthium somewhat compressed in the adnate portion, 2.5–3.5 mm long, c. 0.5 mm wide at midpoint, 1–1.2 mm wide at summit, free in distal 0.4–0.5 mm, with ribs apparently absent or 5- or 10-ribbed but ribs not very prominent, when 5-ribbed the ribs opposite the sepals, somewhat rugose. *Sepals* erect in flower and fruit, scarious, very depressed and rim-like, 0.1–0.2 mm long, 0.4–0.6 mm wide, entire. *Petals* with claw erect and lamina widely spreading in flower, closing erect in fruit, broadly obovate, 0.9–1.3 mm long, white, broadly obtuse, entire, with a few very large oil glands visible on outer surface. *Stamens* 10, the antipetalous ones inserted on inside of summit of disc and antisepalous ones distinctly lower near middle of free tube, all borne well above the style; filament 0.4–0.6 mm long. *Anthers* c. 0.3 mm long; slits very oblique (about half way between parallel and transverse); gland small, almost equally 3-lobed. *Ovary* with 2 ovules in a more or less terminal cavity. *Style* c. 0.4 mm long. *Fruit* cylindrical, the most mature seen c. 2.5×0.7 mm. *Seed* not seen at maturity but apparently c. 2 mm long.

Selected specimens examined. WESTERN AUSTRALIA: 8 km NE of Queen Victoria Spring, 17 Oct. 1995, D.J. Edinger 999 (PERTH); Queen Victoria Spring, in Queen Victoria Spring Nature Reserve, 19 Apr. 1996, D.J. Edinger 1233 (PERTH); 18 miles [29 km] N of Cundeelee, 21 Sep. 1963, A.S. George 5879 (PERTH); 10 km NE of Cundeelee, 2 July 1966, D.W. Goodall 2995 (PERTH); Queen Victoria Spring, Aug. 1975, B.M.J. Husseys.n. (PERTH); 25 km NNE of Queen Victoria Spring, 2 Sep. 1988, D.J. Pearson 501 (PERTH); 6 km SE of Queen Victoria Spring, Queen Victoria Spring Nature Reserve, 7 Sep. 1992, D.J. Pearson 2785 (PERTH); 26 km NNW of Queen Victoria Spring, Queen Victoria Spring Nature Reserve, 8 Dec. 1992, D.J. Pearson 3086 (PERTH); Great Victoria Desert, PNC road, 35.4 km W of Cable Haul Rd, 4 Aug. 2003, Peter G. Wilson 1618 & G.M. Towler (PERTH).

Distribution and habitat. Eremaean Botanical Province: COO, GVD, MUR. Extends from east of Rason Lake south-west to Queen Victoria Spring Nature Reserve. Recorded on the crest or lower down on dunes or undulating sandplains, in yellow or rarely red soils, the vegetation dominated by mallee eucalypts or smaller shrub species, often with *Triodia* hummock grass. (Figure 3B)

Phenology. Flowers recorded April, July to December, especially August to October. Fruits recorded in October and November.

Conservation status. Conservation Codes for Western Australian Flora: Priority Three. Occurs in one large nature reserve, where it appears to be widespread, and its known range extends over 200 km.

Notes. This species sometimes has only five ribs opposite the sepals but appears to be a primarily 10-ribbed species.

Micromyrtus sulphurea W.V. Fitzg., *J. W. Austral. Nat. Hist. Soc.* 2: 19 (1904). *Type:* on rocky hillside 0.5 mile [0.8 km] west of Mount Magnet, Western Australia, September 1903, W.V. Fitzgerald (*holo vel iso:* PERTH 01631357; *iso:* PERTH (ex B) 01631365).

Illustrations. Blackall & Grieve (1980: 44); line drawing on the holotype.

Shrub commonly stunted and 0.2–0.4 m high, often widely spreading, sometimes erect and 0.5–1.5 m high. *Leaves* mostly widely antrorse or antrorse, densely arranged on the smaller branchlets. *Petioles* up to 0.3 mm long. *Leaf blades* usually narrowly oblong to narrowly obovate in outline, $2-4 \times 0.5-0.7$ mm, often thick, broadly obtuse and mucronulate, entire, concolorous; lower surface deeply convex with

very steep sides, sometimes with an indentation along midvein towards base, with 5–10 prominent glands less than 0.2 mm diam.; upper surface convex to shallowly concave, usually almost flat. *Racemes* mostly extending for 2–10 nodes, the flowers antrorse or widely antrorse, tending to become patent in fruit; peduncles (0.6)0.8–1.5(2) mm long. *Bracteoles* caducous, scarious, ovate or narrowly ovate, 1–1.8 mm long, pale brown and sometimes tinged reddish, acute to acuminate, entire. *Buds* with apex hemispheric. *Flowers* 3.5–4.5 mm diam., with several filiform processes 0.1–0.3 mm long opposite each petal; hypanthium with adnate portion almost terete, (1.5)2–3 mm long, 0.5–0.7 mm wide at midpoint, 1.4–1.7 mm wide at summit, free in distal 0.3–0.5 mm, with several fairly obvious ribs on adaxial surface, somewhat concave and less distinctly ribbed on abaxial surface. *Sepals* widely spreading in flower and fruit, somewhat scarious, depressed or very depressed, 0.2–0.4 mm long, 0.5–0.9 mm wide, yellow, broadly obtuse, entire to dentate. *Petals* widely spreading in flower and fruit, very broadly obovate, 1.2–1.4 mm long, sulphur-yellow, broadly obtuse, more or less entire. *Stamens* 10, the antipetalous ones inserted on inside or rarely on top of summit of disc, the antisepalous ones inserted near the middle of the free tube or higher, rarely subterminal (on inside just below summit of disc); filament 0.6–0.9 mm long. *Anthers* c. 0.35 mm long; slits very oblique (closer to transverse than longitudinal); gland with 2 small lateral lobes and a large apical portion. *Ovary* with 2 ovules in a cavity towards the centre of ovary, distinctly below the summit of the ovary cell. *Style* 0.5–1 mm long. *Fruit* obconic, c. 1.8 × 0.8 mm, 1-seeded; hypanthium 10-ribbed. *Seed* narrowly obovoid-obconic, 1.3–1.5 × c. 0.6 mm; testa cream or very pale golden brown.

Selected specimens examined. WESTERN AUSTRALIA: 6 km S of Mt Edon, Maranalgo Station, 26 Nov. 1992, R.J. Cranfield 8632 (PERTH); near Youanmi, 17 Oct. 1966, C.A. Gardner 19027 (PERTH); near track beside Wooramel River, 10.1 km SE of Callythara Springs Homestead, 31 Aug. 1995, G.J. Keighery & N. Gibson 1046 (PERTH); Curbur Station, 10.5 km NNE of homestead, Carnarvon–Mullewa road, 11 Aug. 2000, S.J. Patrick & A. Cochrane 3689 (PERTH); 35 miles [56 km] E of Meekatharra, 10 Sep. 1957, N.H. Speck 778 (PERTH); Mt Barloweerie, c. 20 km S of Wooleen Homestead, 13 Oct. 1975, J.Z. Weber 5073 (PERTH).

Distribution and habitat. Eremaean Botanical Province: CAR, MUR, YAL. Extends from Wooramel River east to near Wiluna and south to Marangalga Station (near Paynes Find). Occurs on lateritic or granitic breakaways and other rocky locations, often in *Acacia* shrubland. (Figure 3D)

Phenology. Flowers recorded mainly August to October. Fruits recorded October to November.

Notes. This species differs from all other ten-ribbed species of *Micromyrtus* in its spreading persistent petals, and is the most obviously yellow-flowered species in that group.

Micromyrtus sulphurea is a very variable species, with some geographical trends evident. The more inland (eastern) specimens tend to be larger plants, sometimes with a longer style, although they may tend to have a shorter hypanthium than the western specimens. There is often evidence of infection, apparently by a fungus, on the young shoots of some of the eastern specimens.

Some 4-merous flowers are present on a specimen from near Sandstone (*H. Demarz* 2624) but these are outnumbered by 5-merous flowers. One specimen from east of Meekatharra (*A. Strid* 20202) has particularly short flowers (hypanthium c. 1.5 mm long) and the antisepalous stamens are subterminal on the disc.

Micromyrtus triptycha* Rye, *sp. nov.

Micromyrtus racemosa var. *latifolia* J.W. Green ms.

Bracteolae caducae vel deciduae. Alabastra ad apicem hemisphaerica. Hypanthium c. 2–3 mm longum, 10-costatum, parte adnata in statu florenti compressa sed in statu fructifero tereti. Sepala erecta, petalis multo breviora. Petala alba, in fructu decidua. Stamina 10, obdiplostemonia, brevissima, antheris filamentis longioribus, triangulara. Ovula 2.

Typus: 15.8 miles [25.4 km] east of Lake Grace, Western Australia, 27 September 1975, *J.W. Green* 4453 (*holo*: PERTH 01630857; *iso*: PERTH 01630865).

Shrub often low (0.1–0.5 m) and usually widely spreading, sometimes erect and 0.7–1.4 m high, often multi-stemmed from near the base and often with decumbent to prostrate branches. *Leaves* closely antorse to patent, fairly densely arranged on the smaller branchlets. *Petioles* 0.4–0.5 mm long. *Leaf blades* narrowly obovate or obovate, 2–6 × 1.2–2.3 mm, broadly obtuse, entire or rarely minutely denticulate; lower surface convex, with usually 6–10 prominent glands up to 0.1 mm diam. in each row, with 2–4 main rows on each side of the midrib; upper surface concave, tending to be paler than lower surface. *Racemes* mostly extending for 6–16 nodes; peduncles 0.5–1.3 mm long. *Bracteoles* usually caducous or deciduous, rather scarious, closely folded and often appearing more or less linear (very narrowly obovate to almost ovate when opened out), 1.2–2.2 mm long, often pale yellowish brown, acute, entire. *Buds* with apex hemispheric. *Flowers* 3–4.3 mm diam.; hypanthium dorsiventrally compressed in adnate portion, 1.9–3 mm long, 0.6–0.8 mm wide at midpoint, 0.8–1.1 mm wide at summit, free in distal 0.4–0.6 mm, 10-ribbed, all ribs similar or rarely with the 5 ribs opposite the sepals more prominent than the ribs opposite the petals, tending to be patterned between the ribs with faint transverse ridges delimiting pits or glands; free portion 0.5–0.6 mm long, not much expanded, sometimes with only 5 of the ribs obvious. *Sepals* erect in flower and fruit, scarious, very broadly or depressed ovate, 0.3–0.5 mm long, 0.5–0.7 mm wide, broadly obtuse, usually entire, sometimes denticulate. *Petals* with claw erect and remainder widely spreading in flower, deciduous in fruit, obovate, 1.3–2 mm long, white or cream, sometimes pink-tinged, broadly obtuse, more or less entire, with some prominent glands on outer surface. *Stamens* 10, the antipetalous ones inserted on summit of disc, the antisepalous ones inserted near the middle of the free tube; filament 0.1–0.2 mm long. *Anthers* 0.3–0.4 mm long, with the cells forming a rounded-triangular to almost globular structure divided by slits into 3 more or less equal sized parts; slits very oblique or more or less transverse; gland erect, very broad (projecting laterally beyond the cells), with 2 lateral lobes smaller than the apical portion. *Ovary* with 2 ovules in cavity in upper half but distinctly below the summit of ovary cell. *Style* 0.3–0.4 mm long. *Fruit* not compressed, 1.6–2.2 × 0.8–1 mm, 1-seeded; hypanthium becoming rounded out, with the ribs less obvious or no longer visible. *Seed* obovoid-conic or narrowly so, 1.3–2 × 0.7–0.8 mm; testa medium golden-brown to dark red-brown.

Selected specimens examined. WESTERN AUSTRALIA: Newdegate–Lake Grace road, 15 Apr. 2003, *T.J. Alford* 221 (Perth); Dragon Rocks Nature Reserve, 17 Aug. 1998, *E. Bennett* & *K. Del Fante* DS7.20 (PERTH); 0.4 km W on unnamed track, 7.6 km N of Creek Rd/Old Newdegate Rd on Tarco Rd, c. 34.5 km ESE of Newdegate, 8 Nov. 1996, *B.J. Lepschi* 3257 & *T.R. Lally* (PERTH); Corrigin road, Dump 1, near Kulin, 28 Sep. 1995, *S. Murray* KKS206 (PERTH); 16 km W of Lake King, 8 Oct. 1974, *B.L. Powell* 74113 (PERTH); 16 km from Hyden on road to Newdegate, 1 Jan. 1983, *A. Strid* 21877 (PERTH); 10.5 miles [17 km] E of Newdegate, 28 Aug. 1973, *M.E. Trudgen* 689 (PERTH); c. 25 km W of Lake Grace near Tarin Rock, 11 Oct. 1974, *D.J.E. Whibley* 5314 (PERTH).

Distribution and habitat. Endemic to the South West Botanical Province, extending from near Harrismith north-east to near Hyden and east to near Lake King: AW, ESP, MAL. Occurs mainly in yellow or brown sandy soils but also recorded from more reddish soils perhaps with some clay present, often with gravel, sometimes at the base or on the slopes of lateritic rises, commonly dominated by mallees (*Eucalyptus*) or various tall shrub species, including *Allocasuarina*. (Figure 3D)

Phenology. Flowers mainly April to November, also recorded December and January. Mature fruits and seeds rarely seen, measured from *T.J. Alford* 221 and *A.S. George* 14437 and almost mature ones from *R.A. Saffrey* 472.

Conservation status. A relatively commonly collected taxon that does not appear to be at risk.

Chromosome number. $n = 11$, voucher: *B.L. Powell* 74113 (not previously published) and $2n = c. 22$ [as *Micromyrtus* sp. aff. *racemosa*], voucher *M.E. Trudgen* 689 (Rye 1979).

Etymology. From the Greek *tritychos* three-fold, triple, referring to the 3-celled appearance of the anthers. Instead of the distinctly doubled cells found in the anthers of most *Micromyrtus* species, this species and its closest relatives (i.e. the *M. triptycha* complex) appear to have anthers with three equal parts arranged similarly to, but less rounded than, those of *Corynanthera*. There do still appear to be two slits, however, suggesting that the upper parts of the two cells have become reduced and closely fused into a single structure of approximately the same size as the still distinct lower parts of each cell. The pollen is released to form a large central mass, and the very broad gland projects laterally on each side of the upper part of the anther cell 'triangle'.

Affinities. The closest named relative of *M. triptycha* is *M. naviculare*; see notes under that species. Previously all members of the *M. triptycha* complex were confused with *Micromyrtus racemosa*, which can be readily distinguished by its thicker leaves and its simpler anthers that are obviously 2-celled and are exceeded in length by the filament. Somewhat less obvious differences in *M. racemosa* are the usually more prominently 10-ribbed hypanthium and the more or less terminal ovule cavity.

The *M. triptycha* complex is similar to *M. rogeri* in having the filament so reduced that it is only about half as long as the anther, but its anther morphology (see under etymology section) is unique in the genus.

Notes. The description given above for *Micromyrtus triptycha* applies only to plants occurring in the main area of distribution of the *M. triptycha* complex; these specimens were previously known as *M. racemosa* var. *latifolia* J.W. Green ms. and later as *M. triptycha* subsp. *tritypycha* ms. Although the plants from this geographic area are very variable, they were thought to consistently differ from other members of the complex in their growth habit, as the label data on the specimens commonly describe them as prostrate or very low-growing. They also tend to have the broadest and least prominently dotted leaves and bracteoles, and the hypanthium is more uniformly tubular (i.e. the least flared at the summit). However, at the only two populations sampled in the current study, the plants were erect and up to 1.4 m high. Some of the specimens collected previously are from graded road verges and may have abnormal growth habits as a result. In view of this new information, it appears that more data are needed before the taxonomy of all members of the complex can be finalised.

Separate descriptions are given below of the specimens from the two other main areas of distribution of the complex not covered in the above descriptions of *M. navicularis* and *M. triptycha*. Scale-forming insects seem to be rare or absent in all members of the complex.

a. Northern specimens of *M. triptycha* complex

Shrub erect, spindly, 0.5–1.4 m high, with a single slender basal stem commonly c. 10 mm diam. or with multiple slender branches or stems from the base. *Petioles* 0.4–0.8 mm long. *Leafblades* narrowly obovate or obovate, 2.5–5 × 1–1.5 mm, entire; lower surface convex, with usually 8–11 prominent glands up to 0.15 mm diam. in each row, with 2 or 3 main rows on each side of the midrib; upper surface concave. *Racemes* mostly extending for 20–30 adjacent nodes; peduncles 0.7–2 mm long. *Bracteoles* caducous to fairly persistent but absent from mature fruits, somewhat scarious, closely folded and almost narrowly obovate from side view, broadest towards the apex, 1.5–2.2 mm long, acute, entire. *Buds* with apex hemispheric. *Flowers* 3–3.5 mm diam.; hypanthium dorsiventrally compressed in adnate portion, 2.3–3 mm long, c. 0.6 mm wide at midpoint, c. 1.3 mm wide at summit, fairly equally 10-ribbed, sometimes somewhat patterned between the ribs with faint transverse ridges delimiting pits or glands; free portion 0.5–0.6 mm long, not much expanded, with ribs tending to be faint. *Sepals* erect in flower and fruit, scarious, very broadly or depressed ovate, 0.3–0.5 mm long, 0.5–0.7 mm wide, broadly obtuse, more or less entire. *Petals* with claw erect and remainder widely spreading in flower, deciduous in fruit, obovate, 1.4–1.6 mm long, white or pale yellow, broadly obtuse, more or less entire, with some prominent glands on outer surface. *Stamens* 10, the antipetalous ones inserted on summit of disc, the antisepalous ones inserted near the middle of the free tube; filament 0.15–0.25 mm long. *Anthers* 0.3–0.4 mm long, with the cells forming a rounded-triangular to almost globular structure divided by indentations into 3 more or less equal sized parts; slits oblique; gland erect, very broad (projecting laterally beyond the cells), with 2 lateral lobes smaller than the apical portion. *Ovary* with 2 ovules in cavity in upper half but distinctly below the summit of ovary cell. *Style* c. 0.3 mm long. *Fruit* not compressed, 2.3–2.4 mm long, c. 0.8 mm wide, 1-seeded; hypanthium becoming rounded out and with less obvious or indistinct ribs. *Seed* narrowly obovoid-conic, 1.9–2 × c. 0.75 mm; testa medium golden-brown to dark red-brown. (Figure 2G)

Other specimens examined. WESTERN AUSTRALIA: between Maya and Wubin, 3 Sep. 1938, W.E. Blackall 3764 (PERTH); 6.6 km NW of Wongan Hills towards Piawaning, 27 Aug. 1976, R. Coveny 7822 & B.R. Maslin (PERTH); 4 miles [6.5 km] S of Maya, 22 Aug. 1957, J.W. Green 1504 (PERTH); Maya Railway Siding, 16.1 km S of Latham on the Wubin–Mullewa road, 20 Sep. 1985, N. Hoyle 308 (PERTH); 100 m W of NE corner of Manmanning Nature Reserve, c. 17 km S of Cadoux, 11 Sep. 1998, G.J. Keighery & N. Gibson 6155 (PERTH); Wongan Hills Experimental Farm, Reserve 18672, Craig Rd, c. 6.5 km N of Wongan Hills, 24 Oct. 1984, K.J. Knight 357 (PERTH); 1 mile [1.6 km] NNW of Maya on Goomalling–Mullewa road, 22 July 1953, R. Melville 4287 & J. Calaby (PERTH); Dowerin, May 1959, B. Rosier 37 (PERTH); Maya East Rd, near the intersection with a road running along the eastern side of the railway line at Maya, 29°52.734'S, 116°30.125'E, 10 Sep. 2003, B.L. Rye 239104, 239105 & M.E. Trudgen (PERTH); 30 miles [48 km] N of Wubin on Mullewa road, 9 Sep. 1962, F.W. Went 127 (PERTH).

Distribution and habitat. Extends from Maya south-east to Dowerin: AW. The Maya locality had yellow-brown fine sand and a large area had been cleared and was (in 2003) extremely species-rich in Myrtaceae and other plant groups. Habitat information for other specimens suggest that the species is always found in sandy soils that are often yellowish, at two localities recorded as being over laterite or gravel. (Figure 3C)

Phenology. Flowers July to October, also recorded in May. Mature fruits and seeds rarely seen but measured from K.J. Knight 357 and B. Rosier 37.

Affinities. This taxon differs from all other members of the *Micromyrtus triptycha* complex in its more northern distribution, which is separated by about 150 km from the closest of the southern populations

of the complex. Its leaves tend to be more prominently oil-dotted and narrower than those of typical *M. triptycha* but broader than those of the *M. navicularis* and the variant from the Ironcaps area. It generally has a longer hypanthium than the latter two taxa resulting in usually longer flowers, fruits and seeds, and tends to have longer sepals, but has similar-sized petals and hence a similar flower diameter.

Notes. Currently housed at PERTH as *M. triptycha* subsp. *longiflora* Rye ms. Specimens from the furthest north near Maya (e.g. *J.W. Green* 1504) tend to have the thickest leaves, and have very prominently gland-dotted leaves and bracteoles. One of these northernmost populations was visited in the current study. Flower colour in this population was either white or pale yellow. Some individuals had caducous bracteoles that were shed from the buds while others had relatively persistent bracteoles that were often still present on immature fruits.

b. Specimens of *M. triptycha* complex from Ironcaps region

Shrub erect, spindly, 1.5–3 m high, presumably single-stemmed at base but lower parts of plants not seen. *Petioles* 0.5–0.6 mm long. *Leaf blades* narrowly obovate, 4–5.3 × 1.1–1.3 mm, entire; lower surface convex, with usually 10–14 prominent glands up to 0.1 mm diam. in each row, with 2 or 3 main rows on each side of the midrib; upper surface concave, tending to be paler than lower surface. *Racemes* mostly extending for 7–26 nodes; peduncles 1.5–3 mm long. *Bracteoles* usually caducous or deciduous, rather scarious, closely folded and often appearing linear (very narrowly obovate to narrowly oblong when opened out), 1.5–2.4 mm long, pale and yellowish, acute, entire. *Buds* with apex hemispheric. *Flowers* 3–3.5 mm diam.; hypanthium with adnate portion dorsiventrally compressed, 1.9–2.3 mm long, c. 0.5 mm wide at midpoint, 0.9–1.1 mm wide at summit, free in distal 0.4–0.6 mm, distinctly 10-ribbed, tending to be patterned between the ribs with faint transverse ridges delimiting pits or glands. *Sepals* erect in flower and fruit, scarious, very broadly or depressed ovate, 0.2–0.35 mm long, 0.3–0.5 mm wide, broadly obtuse, more or less entire. *Petals* with claw erect and remainder widely spreading in flower, deciduous in fruit, obovate, c. 1.4 mm long, white, broadly obtuse, more or less entire, with some prominent glands on outer surface. *Stamens* 10, the antipetalous ones inserted on summit of disc, the antisepalous ones inserted near the middle of the free tube; filament c. 0.2 mm long. *Anthers* 0.3–0.4 mm long, with the cells forming a rounded-triangular to almost globular structure divided by slits into 3 more or less equal sized parts; slits very oblique or more or less transverse; gland erect, very broad (projecting laterally beyond the cells), with 2 lateral lobes smaller than the apical portion. *Ovary* with 2 ovules in cavity in upper half but distinctly below the summit of ovary cell. *Style* c. 0.35 mm long. *Fruit* not compressed, c. 1.8 mm long, c. 0.85 mm wide, 1-seeded; hypanthium brown, 10-ribbed, smooth between the ribs. *Seed* obovoid-conic, c. 1.4 × 0.8 mm; testa dark red-brown.

Specimens examined. WESTERN AUSTRALIA: 1 km N of South Ironcap, 18 Oct. 1995, *R.J. Cranfield* 10595 (PERTH); on northern side of gridline, c. 25 m north-east of South Ironcap, 7 Sep. 1996, *N. Gibson & K. Brown* 3082 (PERTH); ridgeline of South Ironcap, 1 Sep. 1986, *S.D. Hopper* 5375 (PERTH); Middle Ironcap, 12 Oct. 1976, *G.J. Keighery* 885 (PERTH).

Distribution and habitat. Apparently restricted to the Ironcaps region (east of Hyden and north of Lake King): MAL. This taxon is recorded on the ridgeline, upper slopes or base of lateritic or banded ironstone rocks. (Figure 3C)

Phenology. Flowers recorded August to October. Mature fruits and seeds measured on *N. Gibson & K. Brown* 3082.

Conservation status. Conservation Codes for Western Australian Flora: Priority One. This taxon apparently has a very restricted distribution as it is known from only three localities over a distance of c. 11 km.

Affinities and notes. Currently housed at PERTH as *M. triptycha* subsp. *elata* Rye ms., this taxon is the tallest member of the *Micromyrtus triptycha* complex, reportedly 1.7–3 m high, but full details of its habit are still not known. It appears to occupy a similar habitat type to that of *M. navicularis*, although in a more inland area of distinctly lower rainfall. *M. navicularis* is readily distinguished by its narrower leaves and usually has a shorter hypanthium.

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New combinations and lectotypifications for the south-western Australian genus *Astartea* (Myrtaceae)

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Abstract

Rye, B.L. New combinations and lectotypifications for the south-western Australian genus *Astartea* (Myrtaceae). *Nuytsia* 16(1): 149–156 (2006). Three new combinations, *Astartea affinis* (Endl.) Rye, *A. arbuscula* (Benth.) Rye and *A. astarteoides* (Benth.) Rye, are made for species that were initially described in the genus *Baeckea* L. Lectotypes are selected for two of the base names, *Baeckea affinis* Endl. (including its synonym *Astartea endlicheriana* Schauer *nom. illeg.*) and *B. astarteoides* Benth., and also for *Astartea laricifolia* Schauer.

Introduction

Astartea DC. is a south-western Australian genus of the Myrtaceae that was named by De Candolle (1828) based on the single species *A. fascicularis* (Labill.) DC. De Candolle distinguished the genus from *Baeckea* L. by its stamens being in bundles opposite the sepals. A second species with antisepalous stamen bundles was named *Baeckea affinis* by Endlicher (Endlicher *et al.* 1837), a third as *Astartea laricifolia* by Schauer (1843) and five others, including *A. corniculata* Schauer and *A. scoparia* Schauer, shortly afterwards (Schauer 1844).

In his treatment of the Myrtaceae for “Flora Australiensis”, Bentham (1867) named two more species that are now considered to belong in *Astartea*, but placed both of them in *Baeckea* because their stamens were so reduced in number that there were no obvious stamen bundles opposite the sepals. He did, however, recognise the morphological similarity of one of these species to *Astartea* by naming it *Baeckea astarteoides* and he stated that *Astartea* only differed “from the section *Schidiomyrtus* of *Baeckea* in the stamens more or less united at the base opposite the calyx-lobes” *.

In fact, *Astartea s. str.* can be readily distinguished from *Baeckea s. str.* by differences in its stamens and seeds. Any difficulties in separating *Astartea* and *Baeckea* in the past have resulted from the inclusion in both genera of species that did not belong. Most of the anomalous species that have been placed in *Astartea* belong to the genus *Cyathostemon* Turcz., which needs to be reinstated; the others, including one from the Northern Territory, belong to a new genus. Two papers (Rye & Trudgen in prep., Trudgen & Rye in prep.) are now being prepared to remove these species from *Astartea* and reduce its circumscription to that used in early publications up to and including Turczaninow (1852).

**Baeckea* sect. *Schidiomyrtus* (Schauer) F. Muell. is no longer recognised. Bean (1998) listed it, together with its base name *Schidiomyrtus* Schauer, in synonymy under *Baeckea s. str.*

The only recent taxonomic treatments of *Astartea* have been in two regional floras for Western Australia, "Flora of the Perth Region" (Rye 1987) and "Flora of the South West" (Wheeler *et al.* 2002). In the former treatment, all material of *Astartea* from the Perth region was included under the name *Astartea fascicularis*, but the need for additional species to be recognised in the genus was noted. *Baeckea astarteoides* (listed as a synonym of *A. fascicularis* s. lat.) was regarded as part of the genus *Astartea* on the advice of M.E. Trudgen. The other treatment, Wheeler *et al.* (2002), covered the region with the highest density of *Astartea* species. In that flora eight informal names were used based on a preliminary sorting of the specimens into taxa by M.E. Trudgen (pers. comm.) and a ninth species, *Baeckea arbuscula*, was included with the note that this taxon was expected to be transferred to the genus *Astartea*.

Molecular data (Lam *et al.* 2002, Peter Wilson pers. comm.) support the morphological evidence in placing the two species described by Bentham (1867), i.e. *Baeckea arbuscula* and *B. astarteoides*, in the genus *Astartea*.

Astartea is now considered to include over 20 species and is endemic to Western Australia, with its maximum development in the highest rainfall zones of the south-west. Most species occur in or around winter-wet depressions, along watercourses, or in seasonally damp sites associated with granite outcrops or other rocky habitats. They range from dwarf shrubs in low swamp heath (e.g. *A. arbuscula*) to 5 m trees on the banks of seasonally fast-flowing rivers (*A. leptophylla* Schauer). Despite showing a great variation in plant size, the genus is remarkably constant in some aspects of the morphology of its leaves, flowers and seeds. *Astartea* appears to be a natural but taxonomically difficult genus, with many similar species resulting from a relatively recent radiation.

In the current study of *Astartea*, commenced in the latter part of 2002, type material was examined to ascertain the correct application of the available names, most of which had been reduced to synonymy by Bentham (1867). This paper presents the new combinations and lectotypifications that were found to be needed for *Astartea*. This will bring the available names into use prior to the completion of a taxonomic revision of this difficult genus, which must await further field work.

Formal taxonomy

The species listed below are all known from many locations, including some with large populations, and are not currently considered to be threatened.

Astartea affinis (Endl.) Rye, *comb. nov.*

Baeckea affinis Endl. in S.L. Endlicher, E. Fenzl & G. Bentham, *Enum. Pl.* 51 (1837). – *Astartea endlicheriana* Schauer *nom. illeg.*, *Linnaea* 17: 242 (1843). *Type*: "King George Sound" [actually probably collected near Perth, Western Australia, November–December 1833], C.A. von Hügel (*lecto*: W n.v., photograph seen, left specimen of sheet here selected); central and right specimens on the sheet bearing the lectotype (*lectopara*: W n.v., photograph seen).

?*Leptospermum dubium* Spreng. *nom. dubium*, *Syst. Veg.* 2, 492 (1825). *Type citation*: Nov. Holl. (n.v.).

Selected specimens examined. WESTERN AUSTRALIA: "ex horto bot. Petropolitano", Anon. (K); Yallingup, Dec. 1930, W.E. Blackall s.n. (PERTH); Twin Swamp Wildlife Sanctuary, Reserve 27621 in the

Ellensbrook to Bullsbrook area, 13 Jan. 1972, *N.T. Burbidge* 7949 (PERTH); Bowelling–Duranillan road, between Trigwell Bridge Rd and Wunnenberg Rd, SW of Bowelling, 27 Nov. 1994, *V. Crowley* DKN426 (PERTH); Picton Junction, Nov. 1900, *L. Diels & E. Pritzel* s.n. (PERTH); Brixton Rd, Beckenham, Perth, 19 Nov. 1982, *G.J. Keighery* 5389 (PERTH); Chester Forest Block, between Augusta and Nannup, 34°11' S, 115°20' E, 31 Dec. 1990, *G.J. Keighery* 13463 (PERTH); Bartram Rd swamps, Jandakot, 21 Feb. 1992, *G.J. Keighery* 12756 (PERTH); lower Canning River, 2 Jan. 1899, *R. Helms* s.n. (PERTH); Pinjarra, Nov.–Dec. 1877, *F. Mueller* (MEL 75995); Preston River, 8 Dec. 1877, *F. Mueller* (MEL 76007); Wellington district, Dec. 1900, *E. Pritzel* 87 (AD); Mooliabeenee, E of Gingin, 15 Dec. 1953, *R.D. Royce* 4745 (PERTH); South Western Hwy, 0.3 km N of Wealand Rd, N of Waroona, 1 Dec. 2002, *B.L. Rye* 221202 (PERTH); Waterloo, 33°20' S, 115°45' E, 20 Dec. 1984, *Paul G. Wilson* 12148 (PERTH).

Distribution. Occurs in winter-wet depressions on the Swan Coastal Plain from near Gingin south to Yallingup, extending inland to near Bowelling.

Phenology. Flowering is mainly in spring and early summer, from late October to early January, but with spasmodic records through to mid April.

Lectotypification. Schauer (1844) based his illegitimate name *Astartea endlicheriana* on two previously published names, *Leptospermum dubium* Spreng. and *Baeckea affinis* Endl., and hence a lectotype needs to be selected for Schauer's name. As Schauer named the species after Endlicher and saw the specimen Endlicher had based his species on, but did not see any material of *L. dubium*, the type of *B. affinis* is clearly the appropriate one to select as the lectotype of *A. endlicheriana*.

Photographs were examined of three W specimens of *Astartea* collected from the Swan River Colony by Hügel between November 1833 and January 1834. All were labelled as coming from King George Sound and were therefore considered to be possible type material of *Baeckea affinis*. Only one of these three sheets bore material that appeared to match the protologue of *Baeckea affinis*; this sheet was also the only one to match the description of *Astartea endlicheriana* nom. illeg. This sheet bears three pieces of *Astartea*, one of which has larger leaves than the other two and appears to have been collected from a different plant individual, but all appear to be of the same species. The label identifies the material as "*Astartea endlicheriana* Schauer" and directly below this as "*Baeckea affinis* n. sp.". No PERTH specimens of *Astartea* from King George Sound could be found that matched this material, but there are similar specimens from near Perth, where Hügel made collections between 17 November and 19 December 1833 before sailing to King George Sound and making further collections in early January 1834 (Endlicher *et al.* 1837). Evidently the locality given on the type sheet is incorrect.

Specimens on the other two W sheets of *Astartea* did appear to match material from King George Sound. One of them, a sheet bearing a single piece with dense clusters of leaves apparently separated by broadly winged stems, was identified as probably *Astartea laricifolia*. The other sheet, bearing three pieces with short leaves mostly in clusters, could not be identified with any certainty from the photograph as the flowers were not sufficiently clear.

As noted above, three pieces of *Astartea* are attached to the W sheet believed to have been collected from the Perth area. The left piece, which has long linear leaves, is selected as the lectotype because it is the best fit for the protologue, which described the species as having a general appearance similar to that of *Baeckea linifolia* Rudge. The other two pieces, with somewhat shorter leaves, are here treated as lectoparatypes although they may well have been collected from the same population. One recent collection of the species, *G.J. Keighery* 12756, has a similar combination of pieces attached, one kind

with long leaves similar to the lectotype and the other kind similar to the lectoparatype. The long-leaved piece also has much longer horns on the sepals.

Notes. Schauer (1843) based his illegitimate name *Astartea endlicheriana* on a previously published name, *Baeckea affinis* Endl., and on the misapplied name *Baeckea frutescens* Otto & Dietr. non L., and he later (Schauer 1844) listed an even earlier name, *Leptospermum dubium* Spreng., as a synonym of his illegitimate name. Although he did not see the type specimen, Schauer (1844: 115) considered *Leptospermum dubium* to be synonymous with *Astartea endlicheriana* [= *A. affinis*], because specimens of *A. affinis* were housed under the name *L. dubium* in several herbaria. If the earlier name *Leptospermum dubium* could be confirmed as applying to the same taxon as *Baeckea affinis*, the correct epithet for this *Astartea* species would be *dubia* rather than *affinis*. However, no type material of *Leptospermum dubium* was located in this study. Much of Kurt Sprengel's herbarium, apparently including the Myrtaceae, was acquired by Berlin (B) in 1890 and is no longer extant (Stafleu & Cowan 1985: 806). Since the protologue of *Leptospermum dubium* is too brief and lacking in detail to positively identify the species and the type apparently no longer exists, this name is regarded here as a *nomen dubium*.

A much more recent name for *Astartea affinis*, used for example in Wheeler *et al.* (2002), is '*Astartea* sp. Brixton Rd (G.J. Keighery 5389)'. Although once described as a *Baeckea*, this species has the antisepalous stamen bundles that characterise *Astartea*. It is a lignotuberous shrub up to 2 m tall, with white or pink flowers that are usually 6–9 mm in diameter. The flowers have slightly to prominently horned sepals, with the horn of the outer sepals 0.3–0.5(0.9) mm long, up to about 40 stamens, which are all or mostly in distinct bundles of 2–7(10), and a 3-locular ovary with 7–12 ovules per loculus. The fruit is a 3-valvate capsule with usually several seeds 0.7–0.9(1.1) mm long in each loculus.

Astartea arbuscula (R. Br. ex Benth.) Rye, *comb. nov.*

Baeckea arbuscula R. Br. ex Benth., Fl. Austral. 3, 79 (1867). *Type*: King George Sound, heaths between Oyster and Princess Royal Harbours, December 1801, *R. Brown* (*holo*: BM 00758991; *iso*: K, NSW 497662).

Selected specimens examined. WESTERN AUSTRALIA: Albany, Dec. 1902, *C.R.P. Andrews s.n.* (NSW); near Kalgan River, 5 Jan. 1902, *C.R.P. Andrews* 1276 (PERTH); Caldyanup Rd, between Frankland River and Collis Rd, Frankland National Park, 9 Feb. 1995, *A.R. Annels* 5299 & *R.W. Hearn* (PERTH); Pingerup Rd, 1.8 km from South West Coastal Hwy, 13 Feb. 1995, *A.R. Annels* 5309 (PERTH); King George Sound, Feb. 1899, *B.T. Goadby* (K, PERTH); 400 m along a track running NE through the Rudgyard Nature Reserve, Wilson Inlet, 28 Mar. 2000, *B.G. Hammersley* 2432 (PERTH); Thompson Rd, 5 Aug. 1994, *R.W. Hearn* 4385 (PERTH); 1 km W of Elleker, *G.J. Keighery* 8361 (PERTH); Boronia Rd, 0.2 km NW of Collis St, 4 Dec. 2002, *B.L. Rye* 221245 & *R.W. Hearn* (PERTH).

Distribution. Extends along the south coast from the Pingerup Plains area east to Kalgan River, occurring in the seasonally inundated parts of winter-wet flats, with any associated species of *Astartea* occurring more towards the margins of such areas.

Phenology. Flowering occurs mainly from late December to mid-March.

Conservation status. Perhaps mainly because of its small plant size and its very inconspicuous flowers, *Astartea arbuscula* was poorly collected until it was included [as *Baeckea arbuscula*] on the Western Australia's Declared Rare Flora list in 1982. Recent surveys have shown it to be much more common than

previously believed and it is now assigned a Conservation Code for Western Australian Flora of Priority Four (Atkins 2005), meaning that it has been adequately surveyed and is not currently threatened.

Notes. *Astartea arbuscula* is a dwarf shrub, 0.1–0.3(0.4) m tall, without a lignotuber, and has pale to deep pink flowers. The flowers are exceptionally small, only 1.5–2 mm diam., smaller than any other member of its own or related genera, and perhaps the smallest known in the Australian Myrtaceae. Associated with this extreme reduction in flower size is a very reduced stamen number of 4 or 5, with all stamens solitary opposite the sepals, and a 2-locular ovary with the adaxial loculus abortive and a solitary ovule in the abaxial loculus. The fruit is indehiscent, somewhat compressed and lop-sided, and has a solitary seed that is 0.6–0.7 mm long.

Astartea astarteoides* (Benth.) Rye, *comb. nov.

Baeckea astarteoides Benth., Fl. Austral. 3, 80 (1867). *Type:* inland from Cape Le Grand, [Western Australia], *G. Maxwell* (*lecto:* K, here designated; *isolecto:* MEL 72507). *Other material:* along the coast from Bremer Bay to Esperance, [Western Australia], *G. Maxwell* (*lectopara:* MEL 72508). *Excluded syntypes:* King George Sound, [Western Australia], December 1801–January 1802, *R. Brown* (BM 000758990); Lucky Bay, [Western Australia], January 1802, *R. Brown* (BM 000758988, K); damp rocky shores of King George Sound, [Western Australia], December 1821, *A. Cunningham* (K).

Selected specimens examined. WESTERNAUSTRALIA: just N of Thistle Cove, 21 Jan. 1966, *A.S. George* 7531 (PERTH); 12.5 km NNE of Mt Arid, Cape Arid National Park, 30 Oct. 1990, *G.J. Keighery* 11792 (PERTH); adjacent to Helm Arboretum, 17 km N of Esperance on the Norseman road, 24 Oct. 1979, *N.S. Lander* 1066 (PERTH); Cape Le Grand Rd, 4.3 km S of Merivale Rd, 11 Dec. 2003, *B.L. Rye* 231243 & *C.D. Turley* (PERTH); 45 km E of Esperance, *D.J.E. Whibley* 5450 (PERTH); Lake Rd, Esperance, 33°48'15" S, 121°53'09" E, 19 Oct. 1997, *Peter G. Wilson* 1407 & *N. Lam* (NSW, PERTH); Nares Island Beach, near parking area at the end of Nares Island Rd, 33°56'13" S, 121°35'14" E, 21 Oct. 1997, *Peter G. Wilson* 1414 & *N. Lam* (NSW, PERTH).

Distribution. Grows in sandy soils, mainly associated with winter-wet depressions, extending in near-coastal areas from Esperance east to Cape Arid National Park.

Phenology. The flowering time is mainly from late October to January.

Lectotypification. The five collections Bentham (1867) cited for this species belong to two very similar but geographically distinct species, with two King George Sound collections representing the western taxon and three collections (including the lectotype) from the Esperance area and Lucky Bay representing the eastern taxon. Material collected since the 1860s has extended the known range of the western taxon eastwards to east of Mt Manypeaks, but there remains a large disjunction of over 200 km between it and the eastern taxon.

Bentham (1867) noted that the Lucky Bay specimen collected by R. Brown had a much smaller style and stigma than the other specimens, and since this collection was singled out from the others it was not considered for selection as the lectotype. This specimen seems to be from a plant with effectively male flowers as the gynoeceum appears to be abortive. The remaining four collections matched the protologue well. Of these four, the collection selected for lectotypification appeared to be the most suitable as it was of good quality and it was the only one that was known to be represented at more than one herbarium.

Selected specimens of the eastern taxon, for which the name *Astartea astarteoides* is now established, are cited above. The western taxon differs from *A. astarteoides* in having red markings on its seeds, and it forms part of a very variable complex that includes the type material of *Astartea glomerulosa* Schauer. Most members of this complex can be readily distinguished from *A. astarteoides* by their longer pedicels and peduncles and more numerous stamens, but the specimens cited by Benthham (1867) have lower stamen numbers than usual, falling within the range of stamen numbers observed in *A. astarteoides*. The western complex needs further study to determine the status of its variants.

Notes. *Astartea astarteoides* is a spindly non-lignotuberous shrub 0.4–1.5 m high, with small pink flowers 4.5–6 mm in diameter. It is tallest when growing in very dense shrubland with just a few slender flowering stems protruding from the dense foliage of other shrubs. Its flowers have 5–11 stamens, with a maximum of 3 opposite a sepal, and a 3-locular ovary with 6–8 ovules per loculus. The fruit is a 3-valvate capsule with usually several seeds 0.6–0.9(1.1) mm long in each loculus.

In flowers with as few as 5 stamens, at least one sepal has no stamen opposite it. Where 2 or 3 stamens occur opposite a sepal, they are usually not or only partially united into bundles. The occasional occurrence of antisepalous bundles is evidence that the general lack of such bundles in the taxon is purely a result of its marked reduction of stamen number in comparison with most members of the genus.

Astartea laricifolia Schauer in W.G. Walpers, *Repert. Bot. Syst.* 2, 922 (1843). – *Leptospermum laricifolium* A. Cunn. ex Schauer *nom. inval.* in W.G. Walpers, *Repert. Bot. Syst.* 2, 922 (1843). *Type*: “In paludosis ad Sinum Regis Georgii III” [King George Sound, Western Australia], 31 January 1818, A. Cunningham 81 (*lecto*: BM000758993, here designated; possible *isolecto*: BM000758994, 000758995).

Selected specimens examined. WESTERN AUSTRALIA: 18.5 km E of Walpole, track off Peaceful Bay Rd, Walpole Nornalup National Park, 19 Jan. 1989, *A.R. Annels* 664 (PERTH); King George Sound, 1828–1829, *W. Baxter* (BM000603454); 2.2 km S of NE corner of Yelverton Forest Block, 3 Dec. 1996, *N. Casson & T. Annels* SC 29.20 (PERTH); Brockman Hwy 9 km E of Sues Rd intersection, 10 Jan. 2001, *R.J. Cranfield* 16206, 16213 (PERTH); on Meerup River, 50 m N of old track, 34°39'14"S, 115°56'17"E, 27 Feb. 1997, *C. Day & P. Ellery* P 74.1A (PERTH); no locality, *J. Drummond*, [coll. 2?] n. 3 (MEL 76294); Mt Melville, Albany, 18 Dec. 1999, *P. Foreman* 160 (PERTH); Chester Pass, Stirling Range, 16 Jan. 1936, *C.A. Gardner* (PERTH); King George Sound, Jan. 1834, *C.A. von Hügel* (W); 23 km from Denmark on Walpole road, 28 Feb. 1986, *G.J. Keighery* 7964 (PERTH); Bow River, Dec. 1912, *S.W. Jackson* (NSW, PERTH); 1.3 km W of Angrove Rd/Centre Rd intersection, 34°55'S, 116°39'E, 13 Feb. 1997, *C. McChesney & C. Day* W 35.1 (PERTH); Broke Inlet Rd, 4.6 km E of Chesapeake Rd, 23 Jan. 2003, *B.L. Rye* 230176 & *R.W. Hearn* (PERTH); Thompson Rd 2.8 km N of Weld Rd, 23 Jan. 2003, *B.L. Rye* 230182 & *R.W. Hearn* (PERTH); Break Rd, 3.8 km W of Harewood Rd and 6.2 km E of Fernley Rd, 34°51'18"S, 117°09'49"E, 22 Jan. 2003, *B.L. Rye* 230145, *R.W. Hearn & B.G. Hammersley* (PERTH); W across inlet from Walpole township, 34°59'S, 116°43'E, 13 Feb. 1994, *M.E. Trudgen* 12044 (PERTH).

Distribution. Occurs in the extreme south-west corner of Western Australia, extending from Preston River south to Scott River and east to Albany.

Phenology. Flowering is recorded from early December to early March.

Lectotypification. The specimen chosen here as the lectotype has an erect much-branched stem on the left side of a sheet with mixed collections. Of the pieces labelled as being collected by Cunningham, the lectotype is the largest piece and the one with the most pronounced wings on its stems. The number

81 has been cut out and pasted upside down on its label so as to appear to read 18, but it is clear from the handwriting that it should be the other way up. The remainder of its label reads "*Desmia alata* nov. King George's Sound in King's 1st voyage Cunningham", with the date 1818 added in pencil.

The specimens cited above as possible islectotypes have a total of six pieces of plant, all similar to one another but apparently taken from more weeping branches than the lectotype. They are presumably from a different individual in the same population as the lectotype. One further specimen (BM 00758992), mounted on the same sheet as the lectotype, is an earlier collection made in December 1801 and appears to be of a different species.

Notes. This species was identified by the unpublished name '*Desmia alata*' on labels on the isotype sheets, and it has been housed at PERTH under the phrase name '*Astartea* sp. wing tips (*M.E. Trudgen* 12044)', both names alluding to the very prominently winged young stems which distinguish *Astartea laricifolia* from other members of the genus. The species was briefly described and illustrated in Wheeler *et al.* (2002) under its phrase name.

Other notable characteristics of the species are its habitat, height and aromatic oils. *Astartea laricifolia* is restricted to very damp localities with tall vegetation and is often a very tall shrub, reaching a maximum height of about 5 metres. While volatile oils are characteristic of the genus as a whole and many other members of the Myrtaceae, *A. laricifolia* produces an exceptionally strong odour of aromatic oils when its leaves are crushed. The flowers are white, 5.5–8 mm in diameter, and have a 3-locular ovary with 13–16 ovules per loculus. The numerous stamens are in antisepalous bundles of 5–11, occasionally also with a solitary stamen opposite some of the petals. The fruit has usually several seeds 0.6–0.7 mm long in each loculus.

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Three new species of *Lechenaultia* (Goodeniaceae) from south-west Western Australia, and a new key to the genus

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Abstract

Sage, L.W. Three new species of *Lechenaultia* (Goodeniaceae) from south-west Western Australia, and a new key to the genus. *Nuytsia* 16(1): 157–166 (2006). The new species, *Lechenaultia galactites* L.W. Sage, *L. magnifica* L.W. Sage and *L. hortii* L.W. Sage are described and illustrated. All three species are known from the South West Botanical province of Western Australia and all have conservation priority. A new key to *Lechenaultia* is provided.

Introduction

Lechenaultia R.Br. is an attractive genus in the Goodeniaceae that is predominantly Western Australian with approximately 90% endemic to the state (Morrison 1992; Western Australian Herbarium 2001). *Lechenaultia* are mostly perennial subshrubs or herbs commonly found on the sandplain heaths, woodlands or forests of the South West Botanical Province (Morrison 1987; George *et al.* 1979). Four species occur in the Eremaean Botanical Province and tropical regions of northern Australia with one species occurring also in New Guinea (Morrison 1992).

Robert Brown, naturalist with the Matthew Flinders expedition to Australia in the early 19th century, named the genus *Lechenaultia* from collections he made around King George Sound, Albany (Carolin 1992; Sage 2001). John Lindley described the most common species, *L. biloba*, in 1839 from material collected by the first colonial botanist James Drummond. This widespread species has a reasonable amount of variation in the flower and leaf size, with a number of workers attempting to recognize this in the publication of new taxa (Morrison 1986). Morrison's revisional work on *Lechenaultia* in 1986 reduced many of these to synonymy, which agrees with the authors current understanding of the genus.

Charles Gardner, Government Botanist with then State Herbarium 1929–1960, commented on one of his *Lechenaultia* collections from north of Wubin that was at the time identified as *L. biloba*. Gardner wrote "The type (no. J. Drumm. S.R. 1839 P.4) has the long leaves of the Darling Range strain; but there are also specimens of Drummond's with short leaves, although not quite as thick as these". His collection is *L. galactites*, described as new in this paper.

This new species is distinguished from *L. biloba* by its large, mostly white flowers, erect and robust habit, appressed, thick, leaves and a mostly reseeding life history strategy. The 'Flora of the Perth

Region' also describes an entity attributable to the new species as "A variant...in the wheatbelt with small, narrowly elliptic, erect, appressed, obtuse leaves and flowers in more compact corymbs" (Marchant *et al* 1987).

L. biloba is widely available commercially for horticulture and *L. galactites* also has a high potential for this with large showy, white flowers and an erect, robust habit (Sage 2001).

Lechenaultia hortii, known from just east of Perth, is also related to *L. biloba* but distinguished by leaves that have a short mucro with a different stem attachment, fleshy rather than woody stems and a much later flowering period. This species was identified from collections made in the northern Jarrah Forest bioregion as part of threatened flora surveys by amateur botanists Fred and Jean Hort. *L. magnifica* was also discovered by the Hort's and is related to *L. stenosepala* but differs in having wings that are much narrower on the abaxial lobes rather than equal and a denser arrangement of leaves.

The description of the three new species brings the number of *Lechenaultia* species to 29 with 23 endemic to Western Australia.

Materials and methods

Descriptions were made from herbarium material and fresh material taped to A4 size sheets of cardboard (using a technique similar to that mentioned in Hopper & Brown 2001). All new taxa have been seen in the field by the author.

Nomenclature follows Morrison (1992) and the Western Australian Herbarium (2006). Vegetation classifications follow Muir (1977). Bioregions follow Thackway & Cresswell (1995).

New species descriptions

Lechenaultia galactites* L.W. Sage, *sp. nov.

A *Lechenaultia biloba* Lindley floribus plerumque albis, habitu robusto et erecto, foliis appressis, crassis, et plerumque seminiferis differt.

Typus: Kokardine area [precise locality withheld for conservation purposes], 19 October 1999, L.W. Sage, F. Hort, C.A. Hollister LWS 2317 (*holo*: PERTH 05503418; *iso*: AD, CANB, K, MEL, NSW, NY, PERTH 05503485, SYD).

Erect robust, perennial *subshrub* to c. 60 cm, mostly single stemmed at base, glabrous. *Bark* grey and rough lower down the stem. *Leaves* crowded lower on stems, becoming scattered towards inflorescence, narrowly oblong to ovate, 2.0–7.6 mm long, mostly c. 1 mm wide, antrorse to appressed, sessile with a distinct keel or ridge on the outside surface, obtuse, glabrous. *Inflorescence* a monochasium

or dichasium; bracts or inflorescence leaves slightly longer to c. 8 mm, flatter and wider than lower stem leaves. *Sepals* linear to very narrowly lanceolate, 4.5–9 mm long, narrowly acute, glabrous. *Corolla* to c. 25 mm long, white to creamy white to pale blue, throat sometimes yellow, slit on adaxial side to base; glabrous outside, with long soft, simple hairs inside, dense in the throat and becoming more restricted to lobe and wing margins above; lobes almost equal in length but adaxial lobe wings generally narrower giving a distinct two lipped appearance to corolla; adaxial lobe to c. 10 mm wide, abaxial lobe wings to c. 12×7 mm, abaxial lobe wings to c. 4 mm wide, margins entire to unevenly serrated. *Ovary* to c. 22 mm long, linear, glabrous; style to c. 8 mm long, bent, some scattered glandular hairs mostly lower down; indusium pilose above, short bristles on lips. *Mature fruit* not seen. (Figure 1)

Other specimens examined. WESTERNAUSTRALIA (all PERTH): Latham, 27 Aug. 1979, *P. Armstrong* 77; Kulja, 17 Oct. 1937, *W.E. Blackall* 3512; Wubin, 2 Oct. 1962, *F. Lullfitz* L1630; North Beacon 30 Oct. 1996, *M. Kirby* 214; Wubin, 1 Oct. 2001, *F. & J. Hort* 1500; Chiddarcooping Hill Nature Reserve, 9 Oct. 2001, *L.W. Sage* 2388; Kokardine area, 14 June 1982, *B.H. Smith* 177; Bunjil, 5 Sept. 1972, *C.I. Stacey* 172; Kokardine area, 3 Oct. 1979, *J. Taylor, M.D. Crisp & R. Jackson* JT 1078; Wubin, 9 Sept. 1962, *F.W. Went* 119.

Distribution. Known from the northern Avon Wheatbelt bioregion of the South West Botanical province of Western Australia. (Figure 2)

Habitat. The new species prefers the Kwongan heaths of the northern Avon Wheatbelt, predominantly on sandy soils, though it is also known from clay soils and roadside gravel or laterite.

Phenology. Collected in flower from June to October. Peak flowering most likely occurs in September and early October.

Conservation status. Conservation Codes for Western Australia Flora: Priority Three. Currently known from approximately 7 populations scattered throughout the Kwongan heath of the northern Avon Wheatbelt. Potentially under threat from agricultural clearing and road works.

Etymology. The name is taken from the Greek *gala* – ‘milky’, referring to the flower colour, white with a suffusion of blue. The suggested common name is ‘White *Lechenaultia*’ (Sage 2001).

Notes and affinities. This species has been previously recognised under the informal phrase-name ‘*Lechenaultia* sp. Kokardine (*B.H. Smith* 177)’ at the Western Australian Herbarium.

Just over a year after fire at Chiddarcooping Hill Nature Reserve, plants of *Lechenaultia galactites* were observed to be in full flower and had become the dominant lower shrub layer (Sage 2003). Like *L. striata*, these plants were non-suckering (reproducing from seed), as opposed to the related species *L. biloba* which primarily reproduces from suckers (LWS unpublished data; Morrison 1992). This disturbance based life history strategy was also observed by the author at other *L. galactites* populations and appears to be a diagnostic character in identification.

Lechenaultia galactites is distinguished from its closest relative – *L. biloba*, by an erect and robust habit, a reseeding life history strategy, erect to appresses leaves and longer maximum lengths for sepals, corolla and ovary.



Figure 1. *Lechenaultia galactites*, collected from Chiddarcooping Nature Reserve (Sage LWS 2388, PERTH 05503485). As an indication of scale note that the label is 30 mm high and average corolla length is c. 20 mm.

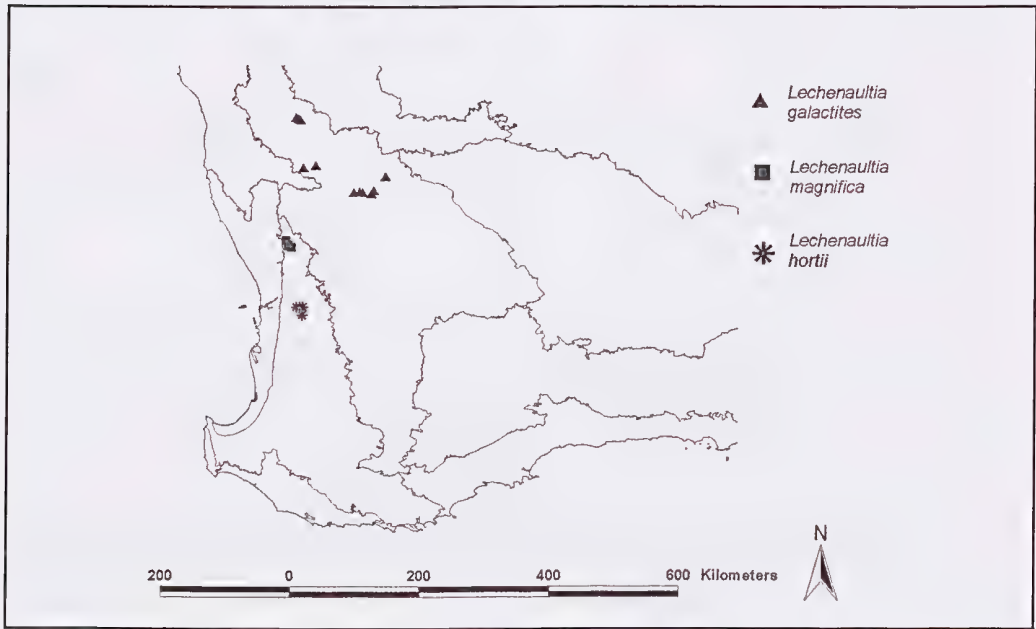


Figure 2. Distribution map for *Lechenaultia galactites* (▲), *L. magnifica* (■) and *L. hortii* (*).

Lechenaultia hortii* L.W. Sage, *sp. nov.

A *Lechenaultia biloba* lindley corollae lobis adaxialibus a lobis abaxialibus distinctis, erectis, super axe dissimili, apice folii graciliter mucronato, et florescentia postea differt.

Typus: SW of York [precise locality withheld for conservation purposes], 17 November 2003, *L. W. Sage, F. Hort, J. Hort, S. Krauss, P. Nikulinsky & M. Parent* LWS 2631 (*holo*: PERTH; *iso*: CANB).

Erect to spreading perennial *subshrub or herb* to c. 40 cm, glabrous, stems fleshy. *Bark* light and flaky only at the very lowest section of the main stem. *Leaves* crowded below and becoming scattered towards inflorescence, thick, linear to very narrowly ovate, 1.4–10 mm long, 0.5–1.0 mm wide, mucronate point, articulation at stem attachment, glabrous, slightly glaucous. *Inflorescence* a monochasium; bracts or inflorescence leaves slightly longer and flatter than stem leaves, very narrowly ovate. *Sepals* linear to very narrowly ovate, 5–10 mm long, mucronate, glabrous. *Corolla* blue to pale blue and white, thick, centre lines and margins of lobes darker, throat yellowish, 10.5–24.0 mm long, slit to base on adaxial side; dense long simple, soft hairs in throat and becoming more restricted to lobe and wing margins above, glabrous outside; lobes almost equal in length but adaxial lobes upheld away from axis of abaxial lobes and with narrower wings giving a distinct two-lipped corolla; adaxial corolla lobes 4–10 mm long, abaxial corolla lobes 4–10.5 mm long, apex of lobes acute and exceeding wings; adaxial corolla lobe wings absent to 2.2 mm wide, abaxial corolla lobe wings 1–4 mm wide. *Ovary* to c. 22 mm long, linear, glabrous; style slightly bent, 5–9 mm long, \pm glabrous; indusium with some simple, soft, erect hairs above and with very short bristles on lips. *Fruit* not seen. (Figure 3)

Other specimens examined. WESTERN AUSTRALIA [precise locality withheld for conservation purposes] (all PERTH): W of York, 9 Dec. 1998, *F. Hort* 326; W of York, 2 Dec. 1998, *F. Hort* 327; York area, 21 Nov. 2002, *F. Hort & A. Lowrie* 1918; SW of York, 9 Jan. 1999, *L. W. Sage, F. & J. Hort* LWS 1460.

Distribution and habitat. Currently known only from three locations west and southwest of York in the Jarrah Forest bioregion of Western Australia. The new species occurs on white-cream sandy soils under *Eucalyptus wandoo* open woodland. Associated species include *Eucalyptus patens*, *Banksia* sp., *Corymbia calophylla*, *Stirlingia latifolia*, *Conospermum stoechadis* and *Hakea prostrata*. (Figure 2)

Phenology. Collected in flower from November to January. Peak flowering seems to occur in very late spring (November) and early summer (December).

Conservation status. Conservation Codes for Western Australia Flora: Priority Two. The new species is known from only three locations, all within a National Park. Potential threats include road works and weeds.

Etymology. The name honours Fred Hort, Threatened Flora volunteer for DEC who brought this species to my attention, recognising his tireless efforts in Western Australian flora conservation. The suggested common name is ‘Hort’s *Lechenaultia*’.

Notes and affinities. The new species is related to *Lechenaultia biloba* but distinguished by fleshy rather than woody stems, a longer maximum sepal length, a corolla texture that is thick and artificial in appearance, adaxial lobes that are held differently and a flowering period that peaks in late spring or early summer rather than late winter or early spring. The new species is similar to *L. biloba* in that it seems to reproduce asexually from adventitious roots. New plants arise from shallow spreading roots that are attached to a vertical taproot (*F. Hort & A. Lowrie* 1918).

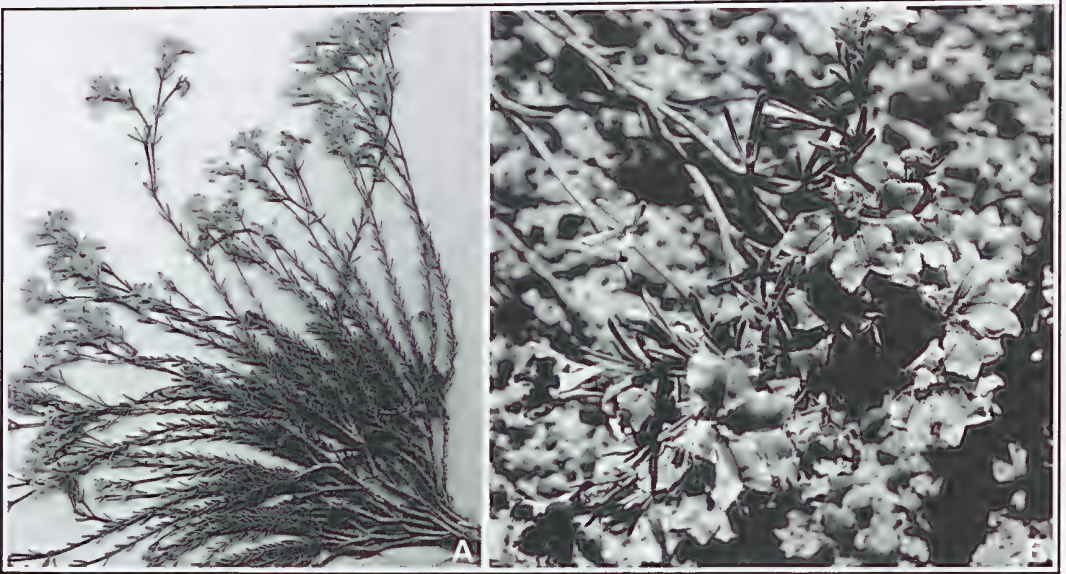


Figure 3. *Lechenaultia hortii*. A – specimen collected from south-west of York (Hort & Lowrie 1918, PERTH 06280552); as an indication of scale note the average corolla length is c. 18 mm. B – habit of living specimen from south-west of York; photo L.W. Sage.

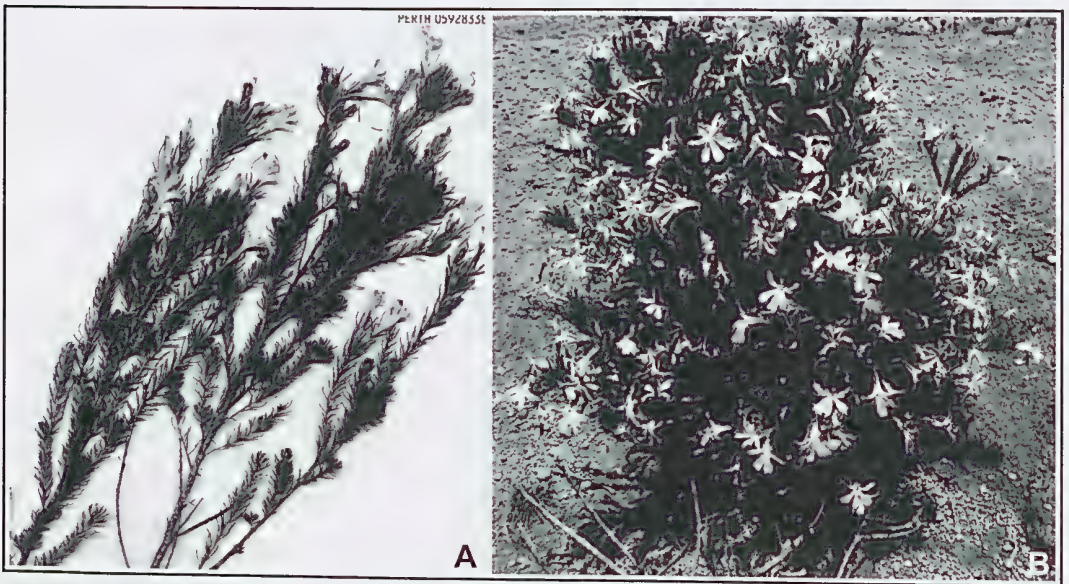


Figure 4. *Lechenaultia magnifica*. A – specimen collected from the Bindoon area (Hislop & Hort MH 2484, PERTH 05928338); as an indication of scale note the average corolla length is c. 23 mm. B – detail from living specimen at Bindoon, north-east of Perth; photo L.W. Sage.

Lechenaultia magnifica* L.W. Sage, *sp. nov.

A *Lechenaultia floribunda* Benth. foliis et sepalis papillatis, sepalis longioribus, corolla longiore differt.

Typus: Bindoon area, Victoria Plains [precise locality withheld for conservation purposes], 6 November 2002, *F. Hort* 1906 (*holo*: PERTH 06230695; *iso*: CANB, K).

Erect perennial *subshrub* to c. 60 cm, papillate on leaves, ovary and often on stem. Bark lower down on stems rough and flaky, light grey, lower stems woody. *Leaves* alternate, papillate, linear to narrowly lanceolate, incurved, crowded right to base of leafy inflorescence, 2.5–12.0 mm long, becoming longer towards inflorescence, very acute to mucronate; attachment to stem on new growth not distinct but with a constriction on older stems. *Inflorescence* a compact, axillary monochasium or dichasium; bracts not distinct from leaves. *Sepals* \pm linear, narrowing to a fine point, 6–8.5 mm long, to c. 0.8 mm wide, \pm equal, glabrous. *Corolla* 16–30 mm long, pink to mauve and/or purple, long, slit on adaxial side to base; glabrous outside, with dense long soft, simple hairs inside throat, becoming more restricted above to lobe and wing margins; lobes almost equal in length, 5–9 mm long, adaxial lobes upheld and with narrower wings; abaxial lobe wings 6–10 mm long, 1.5–4 mm wide, very acute to apiculate, margins undulate to unevenly serrated; adaxial lobe wings 0.5–2 mm wide, margins undulate to unevenly serrated. *Ovary* 6–11 mm long, \pm linear, glabrous; style 14–18 mm long, some scattered glandular hairs lower down; indusium with soft multicellular, non-appressed hairs above, short bristles on lips and often with a purplish tinge, mouth gaping. *Fruit* 17–28 mm long (not including retained sepals), articles 12–19 pairs. (Figure 4)

Other specimens examined. WESTERN AUSTRALIA [precise locality withheld for conservation purposes] (all PERTH): Bindoon area, Victoria Plains, 11 Nov. 2002, *F. Hort* 1907; Bindoon area, Victoria Plains, 25 Nov. 2001, *M. Hislop & F. Hort* MH 2484.

Distribution. This species is currently only known from near Bindoon in the northern Jarrah Forest bioregion of Western Australia. (Figure 2)

Habitat. The new species has been collected from upland, flat, dry lateritic soils in open woodlands of *Corymbia calophylla*, *Eucalyptus wandoo* / *C. calophylla* or *E. marginata* / *C. calophylla*. Associated species included *Hakea trifurcata* and *Calothamnus sanguineus*.

Phenology. Collected in flower early November.

Conservation status. Conservation Codes for Western Australia Flora: Priority One. This species is currently known from only three populations with none known from the conservation estate. Potential threats include road works and weeds. A full survey of this species is required to assess its true status and implement possible remedial action if required.

Etymology. From the Latin, referring to the magnificent floral display produced by this species. The suggested common name is 'Magnificent *Lechenaultia*'.

Notes and affinities. This species has affinities to *Lechenaultia stenosepala* and *L. floribunda*. The new species can be distinguished from *L. stenosepala* by wings that are much narrower on the abaxial lobes rather than equal and a denser arrangement of leaves. The new species is distinguished from *L. floribunda* by having leaves and sepals that are papillate, a longer corolla, a much longer style and longer sepals.

New key to *Lechenaultia*

1. Plants with reduced, scattered leaves with a maximum length under 2 mm
 2. Fruit not woody or persistent; leaves to 1 mm long *L. aphylla*
 2. Fruit woody, persistent; leaves >1.5 mm long *L. divaricata*
1. Plants with obvious leaves that are usually crowded and longer than 2 mm
 3. Corolla tube forming a complete, erect cylinder
 4. Corolla tube gibbous on adaxial side
 5. Sepals greater than 7.5 mm long *L. chlorantha*
 5. Sepals less than 6.5 mm long
 6. Stems with curved down tips; tangled, shrubby habit *L. linarioides*
 6. Stems without curved down tips; prostrate or shortly erect habit *L. formosa*
 4. Corolla tube not gibbous
 7. Plants hispid *L. hirsuta*
 7. Plants glabrous
 8. Plants wreath-like, procumbent herbs; corolla lobe wing 4.5–8.5 mm wide *L. macrantha*
 8. Plants not wreath-like or procumbent; corolla lobe wings <4.5 mm wide
 9. Sepals >16.5 mm long *L. longiloba*
 9. Sepals usually <7.5 mm long
 10. Fruit <7 mm; corolla ≤17 mm long *L. tubiflora*
 10. Fruit >12 mm long; corolla ≥17 mm long
 11. Corolla lobe wings 0.1–0.2 mm wide; sepals <5 mm long *L. acutiflora*
 11. Corolla lobe wings >0.9 mm wide; sepals >5 mm long
 12. Articles 5–8 pairs *L. superba*
 12. Articles 10–20 pairs *L. laricina*
 3. Corolla tube open to base on the adaxial side
 13. Plants papillate (leaves, sepals and ovary)
 14. Sepals <5 mm long; corolla <14 mm long *L. papillata*
 14. Sepals >6 mm long; corolla >16 mm long *L. magnifica*
 13. Plants not papillate
 15. Plants grass-like herbs
 16. Central sepal longer than others
 17. Leaves ovate *L. ovata*
 17. Leaves narrow *L. filiformis*
 16. Sepals all of equal length *L. juncea*
 15. Plants sub-shrubs or non grass-like herbs
 18. Leaves hairy *L. pulvinaris*
 18. Leaves glabrous
 19. Sepals <2.5 mm long *L. subcymosa*
 19. Sepals >3 mm long

- 20. Leaves adpressed to strongly upheld *L. galactites*
- 20. Leaves not adpressed or only incurved
 - 21. Style >11 mm long *L. stenosepala*
 - 21. Style <10 mm long
 - 22. Corolla predominantly blue
 - 23. Sepals to 4.5 mm long or less
 - 24. Leaves on non-flowering stems crowded and scattered
on flowering stems; fruit to 22–29 mm *L. brevifolia*
 - 24. Leaves all crowded; fruit 11–18 mm long *L. floribunda*
 - 23. Sepals 4.5 mm long or greater
 - 25. Style >9.5 mm long *L. heteromera*
 - 25. Style <9 mm long
 - 26. Ovary <6.5 mm long *L. expansa*
 - 26. Ovary >11 mm long
 - 27. Virgate, few branched herb; interior arid distribution *L. striata*
 - 27. Weakly erect to spreading, moderately branched shrub
or subshrub; south-west distribution
 - 28. Stems fleshy; corolla thick and artificial in appearance;
flowering late spring or early summer *L. hortii*
 - 28. Stems mostly woody; corolla thin; flowering peak in
later winter or early spring *L. biloba*
 - 22. Corolla pale yellow to orange–yellow to white
 - 29. Articles 10–13 pairs; sepals to 4.5 mm long or less *L. lutescens*
 - 29. Articles 16–20 pairs; sepals 4.5 mm long or greater *L. striata*

Notes. A new taxon, recently discovered in the Gibson Desert and known by the informal phrase-name '*Lechenaultia* sp. Gibson Desert (C.P. Campbell 2056)' at PERTH, was not included in the key above due to its probable hybrid origins. Both parent taxa for this probable hybrid are currently un-collected or determined.

Acknowledgements

Special thanks to Roberta Cowan, while Australian Botanical Liaison Officer at Kew, and Alex George for arranging and providing images of *Lechenaultia* types in Europe. Many thanks to Paul Wilson for again providing the Latin diagnosis for each taxa, Fred Hort for persisting with his efforts to bring *L. hortii* to my attention, Mike Hislop for bringing *L. magnifica* to my attention, and Ryonen Butcher for her comments on the manuscript.

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New taxa in *Goodenia* subgenus *Goodenia* section *Caeruleae* subsection *Scaevolina* (Goodeniaceae), from the Eremaean Botanical Province of Western Australia

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Abstract

Sage, L.W. & Albrecht, D.E. New taxa in *Goodenia* subgenus *Goodenia* section *Caeruleae* subsection *Scaevolina* (Goodeniaceae), from the Eremaean Botanical Province of Western Australia. *Nuytsia* 16(1): 167–174 (2006). *Goodenia hartiana* L.W. Sage and *G. azurea* subsp. *hesperia* L.W. Sage & Albr. are described, illustrated and mapped with notes on the distribution, conservation status, habitat preferences and relationships to other taxa. Keys to distinguish the new taxa are also provided.

Introduction

Goodenia subgenus *Goodenia* section *Caeruleae* subsection *Scaevolina* Carolin was erected by Carolin (1992) for those species with blue to purple corollas, bracteolate pedicels and colliculate seeds with a narrow wing. Carolin (*op. cit.*) included eight species from central and northern Australia within the subsection. An additional species was described by Holland and Boyle (2002), taking the subsection total to nine species. Recent study of herbarium material and plants in the field by the present authors indicates that further taxa warrant recognition. *G. azurea* is here treated as comprising two subspecies, and *G. hartiana* is recognised as a new species allied to *G. azurea*.

Materials and methods

Descriptive terminology follows Carolin (1992), although it is acknowledged that there are alternative interpretations for some organs (see Albrecht 2002). In cases where the inflorescence is a thyrse and where bracteoles occur not only on a flower stalk but also subtend flowers, the term bract refers only to those structures that subtend the individual cymes of the thyrse.

Floral descriptions are based on spirit or rehydrated material. Corolla length is measured as the distance between the line where the corolla tube abscises from the ovary and the tip of central abaxial corolla lobe.

Nomenclature follows Carolin (1992) and Western Australian Herbarium (2005).

Taxonomy

Goodenia azurea F. Muell., *Fragm.* 1:117 (1859). *Type*: Sturt Creek, [Northern Territory], February 1856, *F. Mueller s.n.* (*holo*: MEL; *iso*: K, *n.v.*).

Dense spreading or sprawling multistemmed *perennial herb or sub-shrub* to c. 1 m high. *Stems* (and main inflorescence axes) glabrous, often glaucous. *Leaves* basal, sub-basal, or extending slightly up the stems, often absent in mature plants, narrowed to a petiole-like base or becoming sessile or sessile as leaves grade into bracts at base of inflorescence; lamina oblanceolate, obovate or spatulate, 8–110 mm long, 3–35 mm wide, glabrous or with minute gland-tipped trichomes 0.1–0.2 mm long on margins or rarely scattered on upper and lower surface, often glaucous, apex obtuse to sub-acute, sometimes recurved, margins entire to dentate, simple hairs sometimes present in leaf axils. *Inflorescence* a leafy divaricate terminal thyrse or raceme (occupying at least ½ height of plant); bracts alternate on main inflorescence axes and subtending cymes or solitary flowers, obovate, oblanceolate, oblong or elliptic, 4–70 mm long, 1–35 mm wide, glabrous or with minute gland-tipped trichomes 0.1–0.2 mm long on margins, entire or dentate, narrowed to a petiole-like base or sessile, sometimes recurved; bracteoles opposite or sub-opposite, broadly ovate, elliptic, oblanceolate, oblong or orbicular, 1.5–26 (–35) mm long, 1–13 (–22) mm wide, glabrous or with minute gland-tipped trichomes 0.1–0.2 mm long on margins, acute to obtuse, margins entire to dentate; peduncles 12–85 mm long, glabrous; pedicels 1.5–20 mm long, articulate 0.5–2.5 mm below the ovary, with an indumentum of minute gland-tipped trichomes above and sometimes for a short distance below the articulation. *Sepals* subequal, adnate to ovary for most of ovary length, free part lanceolate to elliptic, 2–6 mm long, with minute gland-tipped trichomes and sometimes also simple hairs on the margins, apex acute or subacute. *Corolla* 14–22 mm long, blue to purple-blue, outer surface with sparse minute gland-tipped trichomes, inner surface villous in throat and with shorter hairs below, enations in more or less longitudinal rows, usually with short hairs; anterior pouch prominent, 1.2–2.2 mm wide viewed from back, and 1–1.5 mm wide in profile, as long as the ovary. *Abaxial corolla lobes* 5.5–10 mm long, 1.8–3 mm wide; wings 5–8 mm long, 1–2.5 mm wide, entire. *Adaxial corolla lobes* 7–14 mm long, 1.5–2.5 mm wide; auricle indistinct, merged with wing 7.5–11 mm long, 1.8–2.5 mm wide; opposite wing 4.5–7.5 mm long, 1.5–2.5 mm wide, villous below wing. *Stamen* filaments 4.5–6 mm long; anthers 2.5–3.5 mm long. *Ovary* more or less cylindrical, 4–9 mm long, with a dense indumentum of minute gland-tipped trichomes; dissepiment at least two-thirds as long as the loculus; ovules c. 36–50 in two rows in each locule. *Style* 9–11 mm long, slightly curved distally, villous in at least the upper half; indusium obtriangular to obtriangular-oblong, 2.2–3.2 mm long, 2–3 mm wide, sparsely hairy; upper lip slightly convex with bristles 0.3–0.7 mm long; lower lip slightly shorter, with bristles 0.1–0.2 mm long. *Fruit* ovoid-cylindrical or ellipsoidal, 8–13 mm long, 3–5 mm wide, splitting into two valves that are raised 2–3.5 mm beyond point where the sepals become free from ovary. *Seeds* broadly elliptic, 1.7–2.2 mm long, 1.3–1.6 mm wide, colliculate, dark brown to almost black, with a narrow wing c. 0.1 mm wide. (Figures 1A, B)

Two geographically separated subspecies can be recognised, differing most significantly in the shape of the bracteoles and bracts.

Key to the subspecies of *Goodenia azurea*

1. Bracteoles broadly ovate, broadly elliptic or orbicular; bracteoles with a length/breadth ratio of mostly <2:1; bracts usually without a recurved apex; far western Queensland, central Northern Territory & central north-east WA subsp. **azurea**

- 1: Bracteoles oblanceolate, oblong or elliptic, rarely obovate; bracteoles with a length/breadth ratio of mostly $>2:1$; bracts usually with a recurved apex; central Western Australia subsp. **hesperia**

Goodenia azurea* F. Muell. subsp. *azurea

Leaves 20–110 mm long, 10–35 mm wide, glabrous or with minute gland-tipped trichomes 0.1–0.2 mm long on margins or rarely scattered on upper and lower surface, apex usually not recurved. *Inflorescence* a thyse or occasionally reduced to a raceme; bracts obovate or broadly elliptic, 7–70 mm long, 5–35 mm wide, sessile, usually without a recurved apex; bracteoles broadly ovate, broadly elliptic or orbicular, 1.5–26 (–35) mm long, 1.5–13 (–22) mm wide, obtuse to sub-acute; peduncles 17–85 mm long; pedicels 1.5–10 mm long, articulate 1–2.5 mm below the ovary, with an indumentum of minute gland-tipped trichomes above and sometimes for a short distance below the articulation. *Sepals* 3–6 mm long. *Corolla* 14–22 mm long, anterior pouch 1–1.5 mm wide in profile. *Abaxial corolla lobes* 1.8–2.5 mm wide; wings 5–7 mm long. *Adaxial corolla lobes* 10–14 mm long, 1.7–2.5 mm wide; auricle merged with wing 7.5–10 mm long, 1.8–2.3 mm wide; opposite wing 5–6 mm long, 1.5–2 mm wide. *Ovules* c. 36–50 in two rows in each locule. *Indusium* obtriangular-oblong, 2–2.7 mm wide; upper lip with bristles 0.3–0.5 mm long. *Fruit* ovoid-cylindrical, 8–13 mm long. *Seeds* 1.7–2.2 mm long. (Figure 1A)

Selected specimens examined. WESTERN AUSTRALIA: Great Sandy Desert, Tanami Track, c. 2 km W of NT border, c. 225 km SE of Halls Creek, 21 May 1976, *A.C. Beauglehole* 51027 (PERTH). NORTHERN TERRITORY: 41 miles from Mt Doreen, The Granites Rd, 23 Aug. 1970, *R.C. Carolin* 7953 (PERTH); 44 miles NE of Tanami, 12 Apr. 1959, *G. Chippendale* 5658 (AD, BRI, CANB, DNA, K, MEL, NSW, PERTH); The Granites Tenements, Tanami Desert, 5 Dec. 1984, *A.C. Kalotas* 1700 (DNA, PERTH); 19 miles NNE of Inverway Station, 4 July 1949, *R. Perry and M. Lazarides* 2345 (CANB, DNA, PERTH); Buchanan Highway, 53 km E from Duncan Hwy, Victoria River District, 23 Apr. 1987, *R.W. Purdie* 3357 (CANB, DNA, PERTH); Barkly Tableland, Mittiebah Station, near Waterfall Creek, 14 July 2001, *J.A. Risler* 859 and *C.P. Mangion* (AD, B, BRI, DNA, MO). QUEENSLAND: c. 49 km WSW of Lawn Hill homestead, 28 Apr. 2001, *L. Bailey and D. Kelman* (BRI).

Distribution and habitat. Occurs patchily in the Northern Territory between the latitudes of 16°S and 22°S, extending westward into adjacent areas of Western Australia and eastward into Queensland near the Northern Territory border (Figure 2). Numerous collections have been made from the Tanami bioregion with fewer collections from the Mitchell Grass Downs and Great Sandy Desert bioregions.

Almost exclusively associated with lateritised plains, rises and gentle slopes, with or without an overlying veneer of sand, but may also occur in other nearby habitats influenced by ironstone such as sand plains with a mixture of sand and ironstone gravel. Frequently associated species include *Acacia hilliana*, *Eucalyptus brevifolia* and *Triodia* spp. The type subspecies is often found in areas recently disturbed by fire or earthworks.

Flowering period. Flowering may occur at any time of the year given sufficient moisture.

Conservation status. The type subspecies is relatively common in suitable habitat throughout its geographic range.

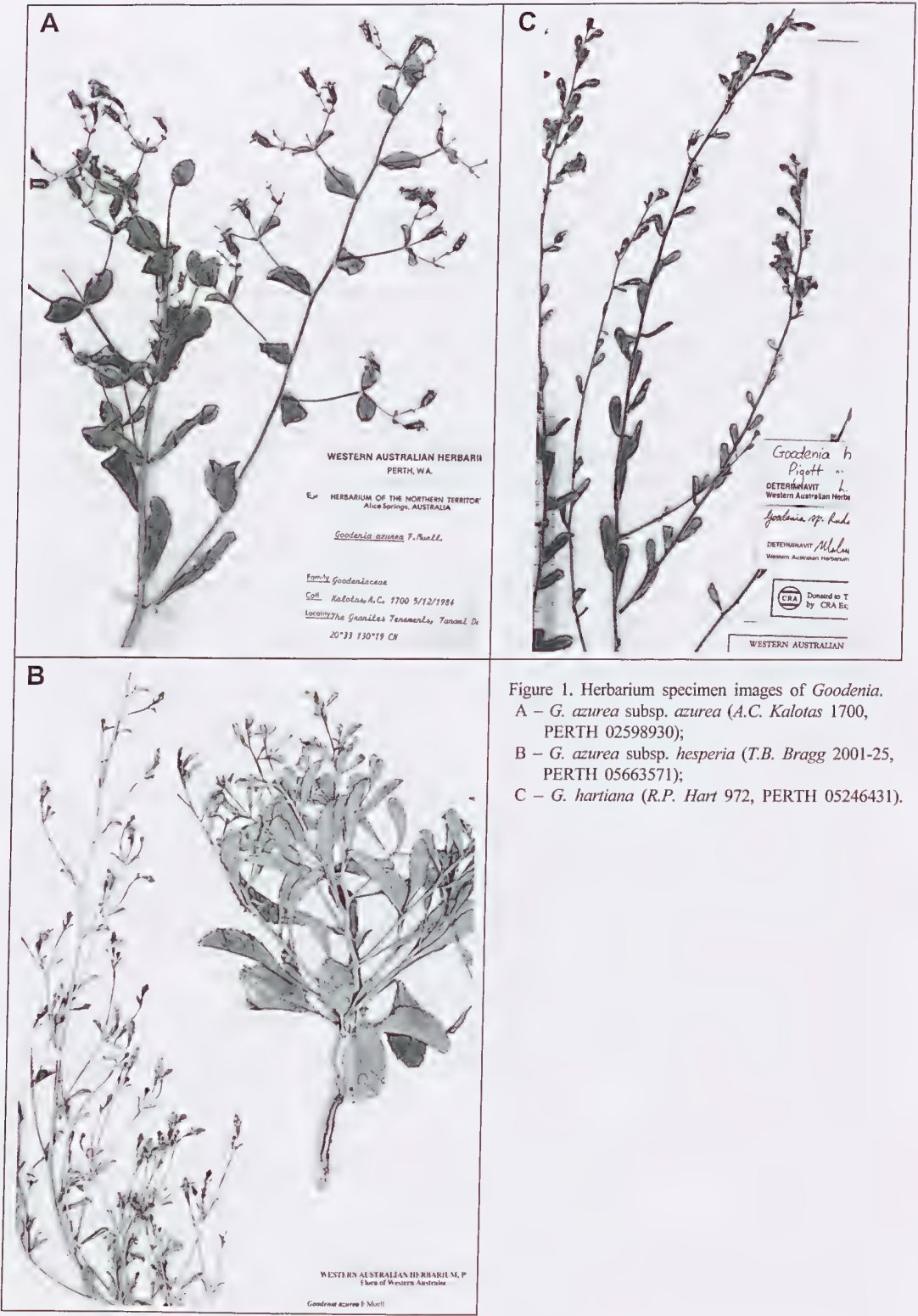


Figure 1. Herbarium specimen images of *Goodenia*.
A – *G. azurea* subsp. *azurea* (A.C. Kalotas 1700, PERTH 02598930);
B – *G. azurea* subsp. *hesperia* (T.B. Bragg 2001-25, PERTH 05663571);
C – *G. hartiana* (R.P. Hart 972, PERTH 05246431).

***Goodenia azurea* subsp. *hesperia* L.W. Sage & Albr., subsp. nov.**

A subsp. *azurea* bracteis oblanceolatis, oblongis vel ellipticis, ratione latitudinis/ longitudinis plerumque $\frac{1}{2}$, et distributione in occidente differt.

Typus: c. 20 km due WSW of Warburton, Western Australia, 12 July 2001, D.E. Albrecht 9865 (*holo*: NT A102696; *iso*: PERTH06755968).

Leaves 8–110 mm long, 3–26 mm wide, glabrous or with minute gland-tipped trichomes 0.1–0.2 mm long on margins, apex often recurved. *Inflorescence* a thyrses or raceme; bracts oblanceolate, oblong or elliptic, rarely obovate, 4–45 mm long, 1–10 mm wide, narrowed to a petiole-like base or sessile, often recurved; bracteoles oblanceolate, oblong or elliptic, rarely obovate, 3–10 (–36) mm long, 1–5 (–8) mm wide, acute to obtuse; peduncles 12–45 mm long; pedicels 4–20 mm long, articulate 0.5–2.5 mm below the ovary, with an indumentum of minute gland-tipped trichomes above the articulation. *Sepals* 2–4.5 mm long. *Corolla* 14–21 mm long, anterior pouch c. 1 mm wide in profile. *Abaxial corolla lobes* 1.8–3 mm wide; wings 5–8 mm long. *Adaxial corolla lobes* 7–14 mm long, 1.5–2.5 mm wide; auricle merged with wing 7.5–11 mm long, 1.8–2.5 mm wide; opposite wing 4.5–7.5 mm long, 1.5–2.5 mm wide. *Ovules* to c. 50 in two rows in each locule. *Indusium* obtriangular to obtriangular-oblong, 2–3 mm wide; upper lip with bristles 0.4–0.7 mm long. *Fruit* ovoid-cylindrical or ellipsoidal, 8–12 mm long. *Seeds* 2–2.2 mm long. (Figure 1B)

Selected specimens examined. WESTERN AUSTRALIA: NE of Mt Madley, 22 May 1996, B. Allwright s.n. (NT); Gibson Desert Nature Reserve, 10 May 1994, A.R. Annels ARA 16A (PERTH); Everard Junction on Gunbarrel Hwy, 2 July 1983, D. Edinger 94 (PERTH); 11–12 miles E of Manunda, Warburton Rd, 20 Aug. 1962, A.S. George 3788 (PERTH); McLarty Hills, Great Sandy Desert, 5 Aug. 1977, A.S. George 14651 (PERTH); Great Sandy Desert, 10 May 1979, A.S. George 15690 (NT, PERTH); 40 miles W of Mt Samuel, near Warburton Mission, 18 May 1958, H.A. Johnson s.n. (NT).

Distribution and habitat. Endemic to Western Australia, occurring in the Great Sandy Desert, Gibson Desert, Little Sandy Desert, Great Victoria Desert, Gascoyne, Pilbara, Dampier Land and Ord-Victoria plains bioregions of the Eremaean and Northern Botanical provinces. (Figure 2)

The limited habitat data available suggests that the new subspecies is typically associated with lateritic plains but may also occur in other habitats influenced by ironstone such as in dune swales with sand and ironstone gravel. At the type location it occurs in very open shrubland with *Acacia aneura*, *A. rhodophloia*, *A. paraneura*, *Goodenia centralis*, *G. triodiophila* and *Triodia basedowii*.

Flowering period. Flowering specimens have been collected from April to October, though it is likely that flowering may occur at any time of the year given sufficient moisture.

Conservation status. Although the new subspecies occurs in a region that is poorly collected, there are sufficient collections and information available to indicate that it is neither uncommon nor threatened. The new subspecies is also represented in the conservation estate in reserves such as Gibson Desert Nature Reserve.

Etymology. From the Greek *hesperos*, meaning ‘of the west’, in reference to the western distribution of the new subspecies.

Goodenia hartiana* L.W. Sage, *sp. nov.

A *G. azurea* F. Muell. affinis sed planta viscosa, sepalis longioribus atque forma sepalorum dissimili, et bracteolis brevioribus differt.

Typus: Rudall River Region, August 1992, R.P. Hart 972 (*holo*: PERTH 05246431; *iso*: CANB, K).

Erect to spreading multi-stemmed *perennial herb or subshrub* to c. 50 cm high. *Stems* (and main inflorescence axes) with minute gland-tipped trichomes. *Leaves* sub-basal or extending slightly up the stems but often absent in mature plants, basal leaves apparently always absent; lamina oblanceolate to narrowly obovate, 6–30 mm long, 2.5–7 mm wide, with sparse minute gland-tipped trichomes on adaxial and abaxial surfaces and margins, apex rounded, margins mostly entire to denticulate, dentation ending in a gland. *Inflorescence* a multi-flowered terminal raceme to c. 12.5 cm long (often occupying at least ½ height of plant); bracts obovate, leaf-like but smaller, 5.2–7.5 mm long, with sparse minute gland-tipped trichomes on both surfaces and margins, apex rounded, mostly entire; bracteoles opposite, narrowly elliptic, narrowly oblong or oblanceolate, 2.5–3 mm long, with minute gland-tipped trichomes mostly on adaxial side; peduncles 3–7 mm long, with minute gland-tipped trichomes; pedicels 1–2 mm long, articulate 0–2.5 mm below the ovary. *Sepals* ± equal, narrowly ovate to lanceolate, 5.2–6 mm long, with minute gland-tipped trichomes on margins and adaxial surface, apex rounded. *Corolla* blue or purple, striate inside, 10–17 mm long, glabrous on outer surface, tufts of simple hairs concentrated near centre of lobes on internal surface and with long simple hairs on lobe wing margins, some minute glandular hairs deep in throat; four rows of enations inside, individual enations to c. 0.3 mm long; pouch distinct, approximately equal to length of ovary; anterior pouch distinct, approximately as long as ovary. *Abaxial corolla lobes* 5–6 mm long, 2.5–3 mm wide, apex rounded; wings 3.3–7 mm long, 1.4–1.9 mm wide, rounded, entire. *Adaxial corolla lobes* 10.5–12 mm long, 2–2.5 mm wide, apex rounded, auriculate; wings on auricle side 6.8–8.7 mm long, 2–2.5 mm wide; wings opposite auricle 4–5.7 mm long, 1.6–2 mm wide. *Stamen* filaments linear, c. 5 mm long; anthers c. 2.5 mm long. *Ovary* more or less cylindrical, 4–5 mm long, with a dense indumentum of minute gland-tipped trichomes; dissepiment c. ¾ as long as the loculus; ovules c. 24 in two rows in each locule. *Style* c. 8 mm long, with long simple hairs; indusium c. 3 mm long, slightly bent transversely, broadly obovate in outline, long simple hairs on lower and upper surface, bristles on upper lip to c. 0.6 mm long, with a purplish tinge, bristles on lower lip almost obsolete. *Fruit* ovoid to cylindrical, to c. 6 mm long, mature fruit not seen. *Seeds* ± ovate, flat, c. 2 mm long, c. 1 mm wide, rim narrow and brown; wing almost obsolete to c. 0.1 mm wide, possibly mucilaginous. (Figure 1C)

Other specimens examined. WESTERN AUSTRALIA: Between Nifty Cooper Mine and Telfer gas pipeline – off route to Nifty-Telfer gas pipeline, Pilbara, 5 Sept. 2005, C. *Days.n.* (PERTH).

Distribution and habitat. Endemic to Western Australia, occurring in the extreme northern Little Sandy Desert and possibly the western Great Sandy Desert bioregions of the Eremaean Botanical province. (Figure 2)

Goodenia hartiana occurs on sand dune swales or sandy areas such as sandy hills. The new species has been observed to be associated with *Eucalyptus* spp., *Acacia* spp. and *Triodia* spp. Further survey and research is required to determine the specific habitat of this species.

Flowering period. *Goodenia hartiana* has been collected in flower in August and September. Flowering is most likely dependant upon adequate rains.

Conservation status. Conservation Codes for Western Australian Flora: Priority Two. *Goodenia hartiana* is known from three locations, only one of which has accurate locality details. This species is poorly collected, geographically restricted and under threat from mining. Full surveys are required to determine the true extent of this species.

Etymology. Named jointly for Raymond P. Hart (1952–2003), who first brought the new species to the attention of LWS, and Anthony Michael Hart (1947–2002), a relation of LWS.

Notes. *Goodenia hartiana* was previously known by the phrase name '*Goodenia* sp. Rudall River (R.P. Hart 972)'. *Goodenia hartiana* superficially resembles *G. azurea* subsp. *hesperia* but differs in having gland-tipped trichomes on the inflorescence axes and peduncles (glabrous in *G. azurea* subsp. *hesperia*). In addition, the leaf and bract lamina surfaces have a sparse indumentum of gland-tipped trichomes in *G. hartiana*, but such trichomes are absent or confined to the margins in *G. azurea* subsp. *hesperia*. In the field plants of *G. hartiana* are glandular-viscid to touch.

A closely-related taxon, once considered within the concept of *Goodenia hartiana*, occurs immediately to the south in the Little Sandy Desert bioregion. This taxon can be distinguished by having much longer sepals, longer and narrower leaves and is more likely to be associated with rocky habitats. This taxon is currently known by the phrase name '*Goodenia* sp. Sandy Creek (R.D. Royce 1653)'.

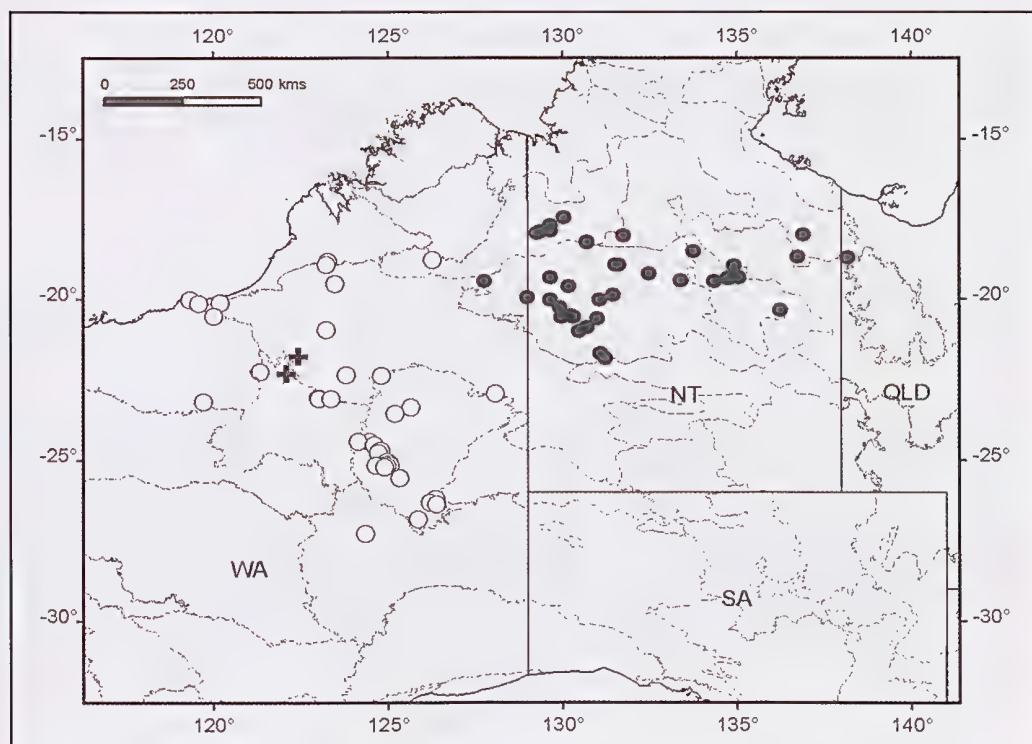


Figure 2. Distribution map with bioregional boundaries (Thackway & Cresswell 1995), *Goodenia azurea* subsp. *azurea* (●), *G. azurea* subsp. *hesperia* (○), *G. hartiana* (+) based on herbarium records from PERTH and DNA.

Amendment to the “Flora of Australia” key to incorporate *Goodenia hartiana*

Inclusion of *Goodenia hartiana* in the *Goodenia* key in the “Flora of Australia” (Carolin 1992: 151) can be made by altering couplet 16 and 17 of Group 1 as follows:

- 16:** Leaves linear to oblanceolate, narrowly elliptic or narrowly obovate, mostly to 7 mm wide
- 17** Sepals to 2 mm long; corolla lacking enations; bracteoles linear; ovules numerous; monsoonal northern Australia..... **17. *G. gloeophylla***
- 17:** Sepals >3 mm long; corolla with enations; bracteoles broader than linear; ovules to c. 24; south-western and arid W.A.
- 17a** Bracteoles >4 mm long; seeds with aculeate cellular projections; south-western W.A. **52. *G. xanthotricha***
- 17a:** Bracteoles to 3 mm long; seeds reticulate to reticulate-foveate; north-western W.A. ***G. hartiana***

Acknowledgements

Thanks to Paul Wilson for preparing the Latin diagnoses, Mark Harris for generating the map, Ailsa Holland for providing information on a specimen at BRI, Stephen van Leeuwen for providing the opportunity for the authors to undertake fieldwork in the Little Sandy Desert and the Pilbara, and to Malcolm Trudgen for first recognising the new taxa described in this paper and for his taxonomic advice.

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***Lasiopetalum pterocarpum* (Malvaceae s.l.: Lasiopetaleae),
a new and rare species from south-west Western Australia**

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Abstract

Shepherd, K.A., Bennett, E.M., Wilkins, C.F. and Sage, L.W. *Lasiopetalum pterocarpum* (Malvaceae s.l.: Lasiopetaleae), a new and rare species from south-west Western Australia. *Nuytsia* 16(1): 175–181 (2006). *Lasiopetalum pterocarpum* E.M. Benn. & K.A. Sheph. *sp. nov.* is described and illustrated. The distinct winged fruit, for which *L. pterocarpum* is named, is unique within Lasiopetaleae. *Lasiopetalum pterocarpum* is allied to *L. floribundum*, which shares a similar habit, large ovate leaves and loose dichasial inflorescences. It can be readily distinguished from *L. floribundum* by its discolorous and strongly-lobed leaves, the absence of glandular hairs on the peduncles, and its larger seeds. This species is known from only one population south of Perth and is classified as critically endangered.

Introduction

Lasiopetalum Sm. (tribe Lasiopetaleae Gay, Malvaceae Juss.) is a genus that currently includes 36 species and one variety. It occurs mainly in the southern regions of Australia but extends north through New South Wales to southern Queensland. This genus has not been comprehensively revised since Bentham's treatment in *Flora Australiensis* (Bentham 1863), although six new species were circumscribed by Paust (1974).

During examination of material housed at the National Herbarium of New South Wales (NSW), KAS noticed that a specimen collected in 1899 by R. Helms from the Serpentine area was morphologically distinct (Figure 1). A single population was subsequently discovered in 1995 from a similar locality (K. Shepherd & J.A. Wege KS 360). No other populations are known. A revision of *Lasiopetalum* for the *Flora of Australia* is in progress and includes a number of new taxa. The description of *Lasiopetalum pterocarpum* E.M. Benn. & K.A. Sheph. is published here in view of its rarity.

Methods

This research is based on observations of herbarium specimens from PERTH and material loaned from NSW. Floral characters were scored from fresh, rehydrated or spirit material preserved in 70% ethanol. Seed and seed coat morphology was examined using vouchers collected by CFW. Photographs of seed

were taken using Zeiss Axiocam system mounted on a dissecting microscope. The seed coat testa was examined using an Environmental Scanning Electron Microscope (Danilastos 1993). The species distribution map was created using the Online Map Creation (OMC) program with GMC software (<http://www.aquarius.geomar.de/omc/>).



Figure 1. *Lasiopetalum pterocarpum* – specimen in NSW collected by R. Helms in 1899. A duplicate is lodged at BRI.

Taxonomy

Lasiopetalum pterocarpum* E.M. Benn. & K.A. Sheph., *sp. nov.

Folia ovata discoloris et valde lobata. Pedunculus in pilis stellatis dispersis obtectus. Fructus in alis inter lineas dehiscentias evolutus.

Typus: WESTERN AUSTRALIA: Serpentine National Park [precise locality withheld], 26 October 1995 K. Shepherd & J.A. Wege KS 360 (*holo*: PERTH 07319193).

Habit Multi-stemmed, open shrub 0.2–1.2 × 0.2–0.5 m. *Stems* with scattered, large, ferruginous, stellate hairs 1–1.26 mm diam., over dense, sessile, white, stellate hairs 0.25–0.27 mm diam.; mature stems reddish brown or brown, becoming glabrous with age. *Stipules* absent. *Petiole* 4–14 mm long, hairs as on young stem. *Leaves* ovate, 25–80 × 15–50 mm, distinctly lobed, flat or slightly incurved; apex acute to obtuse; discolorous; adaxial surface with scattered white or ferruginous, sessile or stalked, stellate hairs 0.3–0.7 mm diam., becoming glabrous with age; abaxial surface with scattered, ferruginous, stellate hairs 0.75–0.9 mm diam., more dense on mid rib, over tomentose, white, sessile, stellate hairs 0.4–0.5 mm diam. *Inflorescence* a loose, compound dichasium, leaf opposed, 32–62 mm long, with 5–8 (11) flowers, occasionally a simple dichasium with 2 or 3 flowers. *Peduncles* 9–55 mm long with scattered, ferruginous or white-stalked, stellate hairs 0.75–0.8 mm diam., over dense, sessile, stellate hairs, 0.3–0.5 mm diam., becoming glabrous towards the base. *Pedicels* 0.6–4 mm long, hairs as on peduncle. *Bract* one, at base of pedicel, oblong, 0.8–3.8 × 0.2–0.4 mm. *Bracteole* one, 0.5–0.7 mm from base of calyx, filiform, 0.7–2 × 0.2–0.5 mm, with scattered, stalked, ferruginous or white, stellate hairs to 1.0 mm diam. over dense, white, stellate hairs, 0.25–0.3 mm diam. *Calyx* pink, base dark red to purple; almost divided to base, tube 0.2–0.5 mm long; lobes narrowly-ovate, 5.7–8 × 1–2.3 mm, apex acute; outer surface white, with scattered, stalked, ferruginous or white stellate hairs, over sessile stellate hairs, denser at the calyx base; inner surface with scattered, fine, white, stellate, hairs, glabrous at base. *Petals* absent. *Anthers* elliptic, dark purple, 1.4–1.8 × 0.6–0.7 mm, with apical pores; pollen white. *Filaments* glabrous, 0.75–1 × 0.15–2 mm. *Ovary* 3-celled, 0.7–1 × 0.9 mm, inner surface glabrous, outer surface tomentose with white, stellate hairs and scattered, stalked, clavate glandular hairs. *Ovules* 2 in each cell. *Style* 3–3.7 mm, base with dense, white, stellate hairs at junction with ovary, central c. 2 mm with stalked, white, fan-shaped, reflexed, stellate hairs, 0.3–0.4 mm long, glabrous towards the apex. *Fruit* transversely ellipsoid, distinctly 6(–12) winged between the dehiscence lines, 0.7–2.5 × 1.3–3.6 mm, outer surface with dense stellate and glandular hairs, inner surface of the loculi glabrous. *Seed* ellipsoid, 2.8–3.4 × 1.4–1.5 mm, exotesta black, smooth with scattered, stellate hairs; aril yellow, 1.4–1.5 mm long. (Figures 2, 4)

Specimens examined. WESTERN AUSTRALIA: Serpentine National Park [precise localities withheld]. 22 Oct. 1899, R. Helms s.n. (BRI, NSW); 5 Aug. 1972, S. Paust 1103A (BRI, PERTH); 8 Dec. 1996, A. Markey 1021 (PERTH); 30 Jul. 1997, J.L. Robsons s.n. (PERTH); 7 Sep. 1999, V. English 1200 (PERTH); 24 Sep. 1999, V. English & R.M. Evans s.n. (PERTH); 12 May 2006, C. Wilkins 2157 (CANB, MEL, NSW, PERTH, UWA).

Distribution. Restricted to one population near Serpentine, c. 48 km south of Perth, Western Australia. (Figure 3)

Habitat. Grows in dark brown or red brown, loam or clayey-sand, over granite, near creek lines and on sloping banks. Associated with *Eucalyptus rudis*, *Corymbia calophylla* woodland over dense thickets of *Trymalium floribundum*, *Acacia* and *Grevillea*.

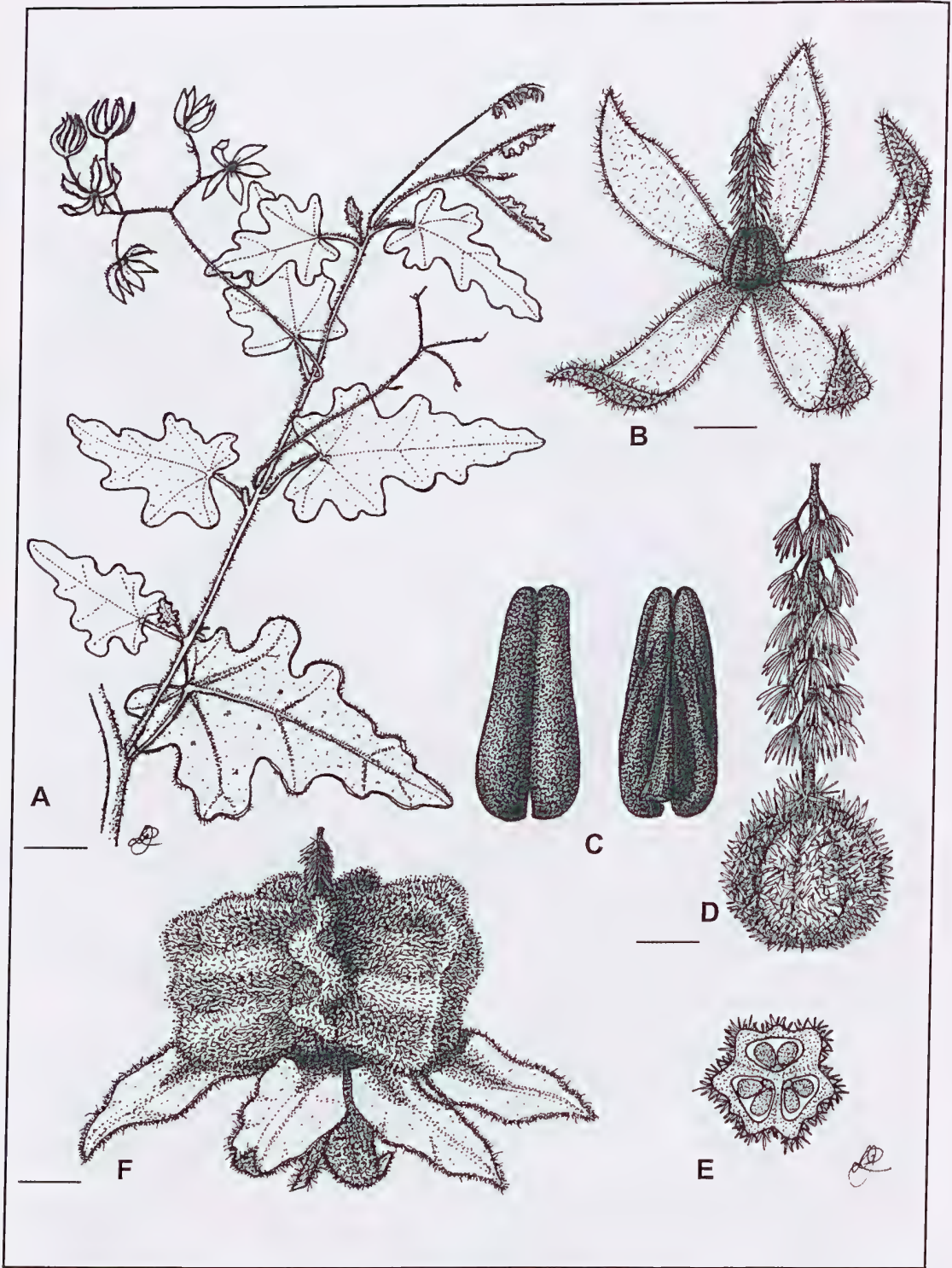


Figure 2. Illustration of *Lasiopetalum pterocarpum*. A – habit; B – flower; C – anthers (abaxial, adaxial); D – gynoecium; E – t.s. of young ovary; F – winged fruit. (Scale bars: A – 10 mm; B – 2.5 mm; C–E – 0.5 mm; F – 2 mm.)

Phenology. Flowering from August to December.

Conservation status. Conservation Codes for Western Australian Flora: Rare. In 1998, this species was ranked as Critically Endangered; it is only known from a single population with c. 550 mature individuals (Wilkins *et al.*, in prep).

Etymology. Derived from the Greek (*ptero* – winged; *carpum* – fruit), in reference to the unique wings that develop between the dehiscence lines as the fruit matures. (Figure 4C)

Affinity. The distinctly winged fruit of *L. pterocarpum* is unique within the tribe Lasiopetaleae. Some species of *Seringia* (Wilkins 2002) have wings on the dehiscence lines, rather than between the dehiscence lines as seen in *L. pterocarpum*. It is closely allied to *L. floribundum* with which it shares broadly-ovate leaves, a loose dichasial inflorescence, and pale pink or white flowers, with the calyx lobes divided almost to the base. While *L. floribundum* possesses entire to slightly irregularly lobed leaves bearing scattered stellate hairs, *L. pterocarpum* has leaves that are distinctly lobed and discoloured due to a dense indumentum on the abaxial surface. The peduncle of *L. pterocarpum* is covered in stellate hairs, while in *L. floribundum* both stellate and glandular hairs are present. *Lasiopetalum pterocarpum* also has larger flowers and seeds than *L. floribundum*. (Figure 4D)

Notes. This taxon has been previously known by the phrase name '*Lasiopetalum* sp. Serpentine (S. Paust 1103A)'. The epidermal cell pattern on the seed exotesta is similar to that observed in *L. compactum* Paust (Wilkins 2002) and the aril belongs to subtype 3a of Wilkins & Chappill (2002). (Figure 4E)

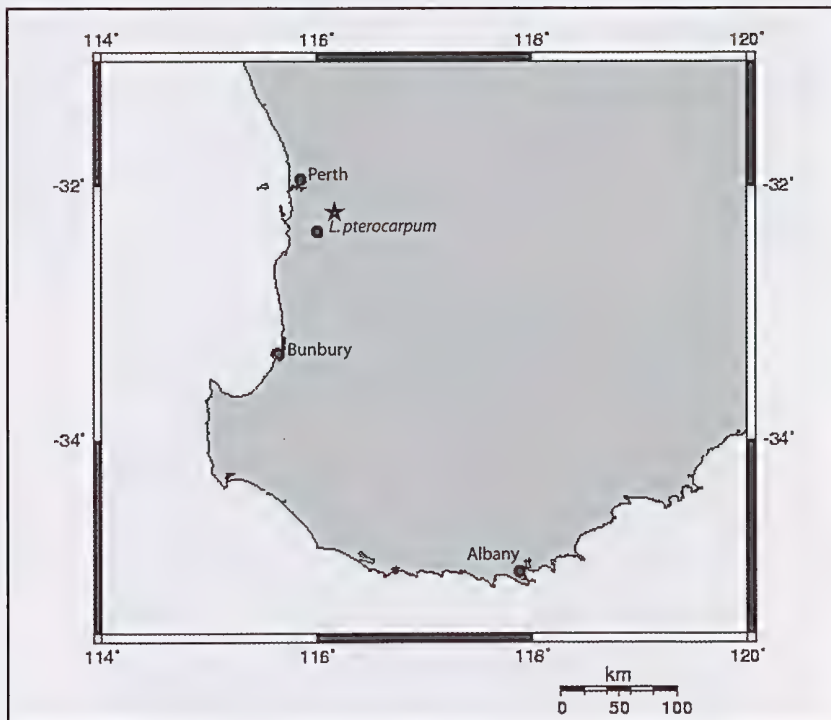


Figure 3. Distribution of *Lasiopetalum pterocarpum* (★).

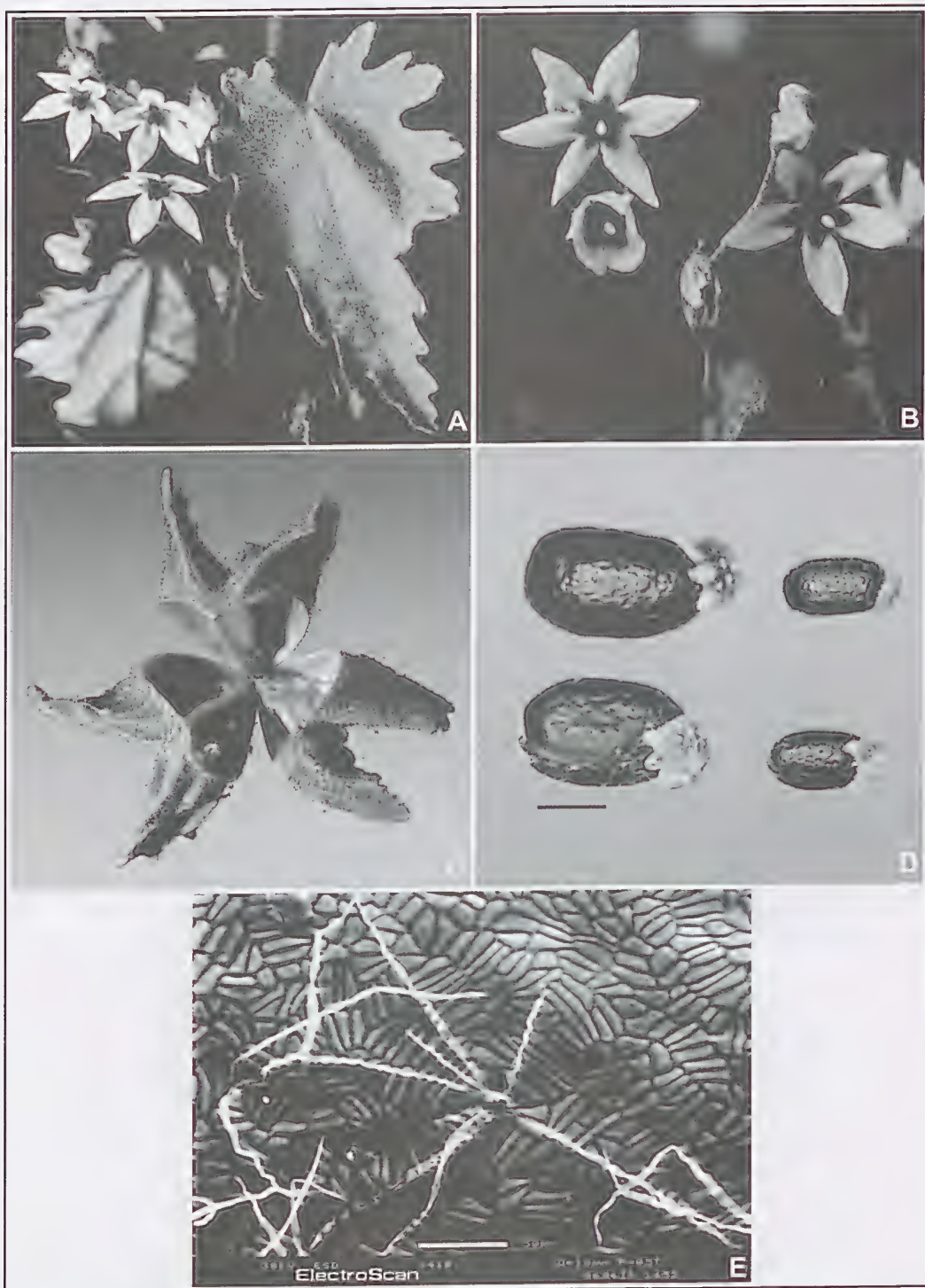


Figure 4. *Lasiopetalum pterocarpum*. A – distinctly lobed, discolorous leaves; B – inflorescence a loose dichasium, calyx pink with a deep purple-red throat and lobes divided almost to the base; C – the distinct winged fruit of *L. pterocarpum*; D – seed of *L. pterocarpum* (left) and *L. floribundum* (right), (scale bar = 1 mm); E – Environmental Scanning Electron micrograph of a seed of *L. pterocarpum* showing the epidermal cells of the seed exotesta and the presence of scattered stellate hairs (white scale bar = 50 μ m).

Acknowledgements

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***Stylidium diplotrichum* (Stylidiaceae): a new scale-leaved trigger plant from south-west Western Australia, with taxonomic and anatomical notes on allied species**

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Abstract

Wege, J.A. *Stylidium diplotrichum* (Stylidiaceae): a new scale-leaved trigger plant from south-west Western Australia, with taxonomic and anatomical notes on allied species. *Nuytsia* 16(1): 183–197 (2006). A new scale-leaved trigger plant with conservation priority, *Stylidium diplotrichum* Wege, is described and illustrated. Revised taxonomic descriptions and notes are also provided for the priority species *S. pseudohirsutum* Mildbr. and *S. expeditionis* Carlquist, and the more commonly occurring *S. hirsutum* R.Br. and *S. crossocephalum* F.Muell. Leaf anatomy data are provided for all species. The location of the stomata is shown to be taxonomically informative.

Introduction

Stylidium subgenus *Tolypangium* (Endl.) Mildbr. section *Squamosae* (Benth.) Mildbr. comprises approximately 20 species of perennial trigger plants, all of which are endemic to the south-west of Western Australia. Members of this section are often referred to as “scale-leaved” trigger plants since they are characterised by membranous scale-leaves that are distributed around or amongst a basal rosette of linear, grass-like leaves. Despite the similarity in habit between these species, allied species often show differences in flower morphology, geographic distribution, habitat preference, chromosome number and karyotype (Carlquist 1969; James 1979; Coates 1982; Lowrie *et al.* 1998).

Examination of the material housed at PERTH uncovered two scale-leaved specimens, collected in the 1970’s from the Lesueur region, not referable to any of the known taxa from section *Squamosae*. Subsequent field searches relocated this entity and confirmed it to be a distinct new species. A description and illustration are provided here, along with revised descriptions for the scale-leaved species *S. pseudohirsutum* Mildbr., *S. expeditionis* Carlquist, *S. hirsutum* R.Br. and *S. crossocephalum* F.Muell. These species share a number of features in common with the new species and are included here for comparative purposes only. A complete revision of section *Squamosae* is in progress and will be published in due course.

Materials and methods

This study is based on herbarium specimens housed at AD, BM, CANB, CGE, K, MEL, P, PERTH, RSA and W, and on the field observations of the author. The majority of morphological characters were

coded using a combination of fresh, spirit and herbarium material. Corolla lobe measurements were based solely on the following spirit collections: *S. crossocephalum* – Wege JAW 22, JAW 590, JAW 596, JAW 606, JAW 615, JAW 622, JAW 634, JAW 727; *S. diplotrichum* – JAW 730, ADC 272; *S. expeditionis* – JAW 697; *S. hirsutum* – JAW 165, JAW 295, JAW 298, JAW 819, JAW 828, JAW 832, JAW 840; *S. pseudohirsutum* – JAW 1142.

Anatomical investigations were conducted on leaf material sampled from 1 plant from the following populations: *S. crossocephalum* – Wege JAW 22, JAW 606; *S. diplotrichum* – JAW 730, ADC 272; *S. expeditionis* – JAW 697; *S. hirsutum* – JAW 165, JAW 298; *S. pseudohirsutum* – JAW 302. Leaves were fixed in 2.5% glutaraldehyde in phosphate buffer or FAA (commercial formalin, glacial acetic acid, and 70% ethanol in the ratio of 1:1:18 parts, respectively). This material was dehydrated, infiltrated and embedded in glycol methacrylate (GMA) according to standard methods (Feder & O'Brien 1968). Transverse and longitudinal sections were made at 2.5 µm using a glass knife rotary microtome, then stained with Toluidine Blue pH 4.4 and mounted in water or paraffin oil for examination using light microscopy (O'Brien & McCully 1981). Anatomical photographs were taken using a Zeiss Axioplan 2 Microscope. The distribution pattern of the stomata, visible under a dissecting microscope as longitudinal bands, was confirmed on all herbarium specimens examined.

Data were recorded as a DELTA dataset (Dallwitz *et al.* 1993), from which species descriptions were generated. Maps were compiled using NatureMap, a departmental mapping application.

Leaf anatomy

The epidermis comprises a single row of thick-walled, axially elongated cells. With the exception of *S. expeditionis*, these cells are obliquely arranged (Figure 1A) and consequently the epidermis appears 1–2 cells thick in transverse section (Figures 1B–E). This unusual feature, first documented by Burns (1900) and later used by Mildbraed (1908) in his infrageneric classification of *Stylidium*, is characteristic of the scale-leaved trigger plants as well as some perennial species from other sections (Mildbraed 1908; Wege, unpublished data). The epidermal cells in *S. expeditionis* are usually transversely arranged and therefore only one cell layer is typically seen in transverse section (Figure 1F). The cross walls are, however, oblique in some cases (Figure 1G) and as such the epidermis occasionally appears two cells thick in transverse section.

Fibrous papillae may form from projections of the thickened epidermal cells. They are abundant across the leaf surface in both *S. crossocephalum* and *S. expeditionis*, giving the leaves a densely pubescent appearance. The papillae vary in density in *S. diplotrichum*: there is usually an even coverage in the lower portion of the leaf, but they are usually restricted to the midrib region on the distal portion of the leaf. *Stylidium pseudohirsutum* typically has scabrous leaves; however, the papillae vary in density between and within populations, and the occasional plant has glabrous leaves. Conversely, the leaves in *S. hirsutum* are typically glabrous, but papillae are present in several populations (see notes under that species).

The leaves of *S. hirsutum*, *S. pseudohirsutum* and *S. crossocephalum* have involute margins (Figures 1B–D). Although the occurrence of involute leaf margins was accurately noted by Mueller (1868) in his description of *S. crossocephalum*, and later by the anatomist Burns (1900), members of section *Squamosae* have most commonly been described as possessing revolute margins (Bentham 1869; Mildbraed 1908; Erickson 1958; Carlquist 1969; Lowrie *et al.* 1998). This feature is likely to have been misinterpreted since the leaves tend to twist over the course of their length. The involute margins

provide a degree of protection for the stomata, which are found in two bands, located on either side of the midvein on the adaxial surface. They occur in association with transversely orientated epidermal cells with thinner walls and thick cuticles. Two additional bands of stomata are present on the abaxial surface in both the new species – *Stylidium diplotrichum* Wege (Figure 1E) and *S. expeditionis* (Figure 1F). In the latter species, the leaves are distinctly bisulcate on both surfaces. The distribution of stomata is a stable taxonomic character in this species complex and they are readily visible on fresh or herbarium specimens with the aid of a dissecting microscope or hand lens.

Palisade tissue is discrete in all species and consists of one to three layers of anticlinally-elongated cells which are lobed and axially elongated in longitudinal section (Figure 1A, G). The palisade is located beneath the fibrous epidermal cells. More rounded spongy mesophyll cells are present to the inside of the stomata channels. Sclerenchyma is associated with the central vascular bundle in all species.

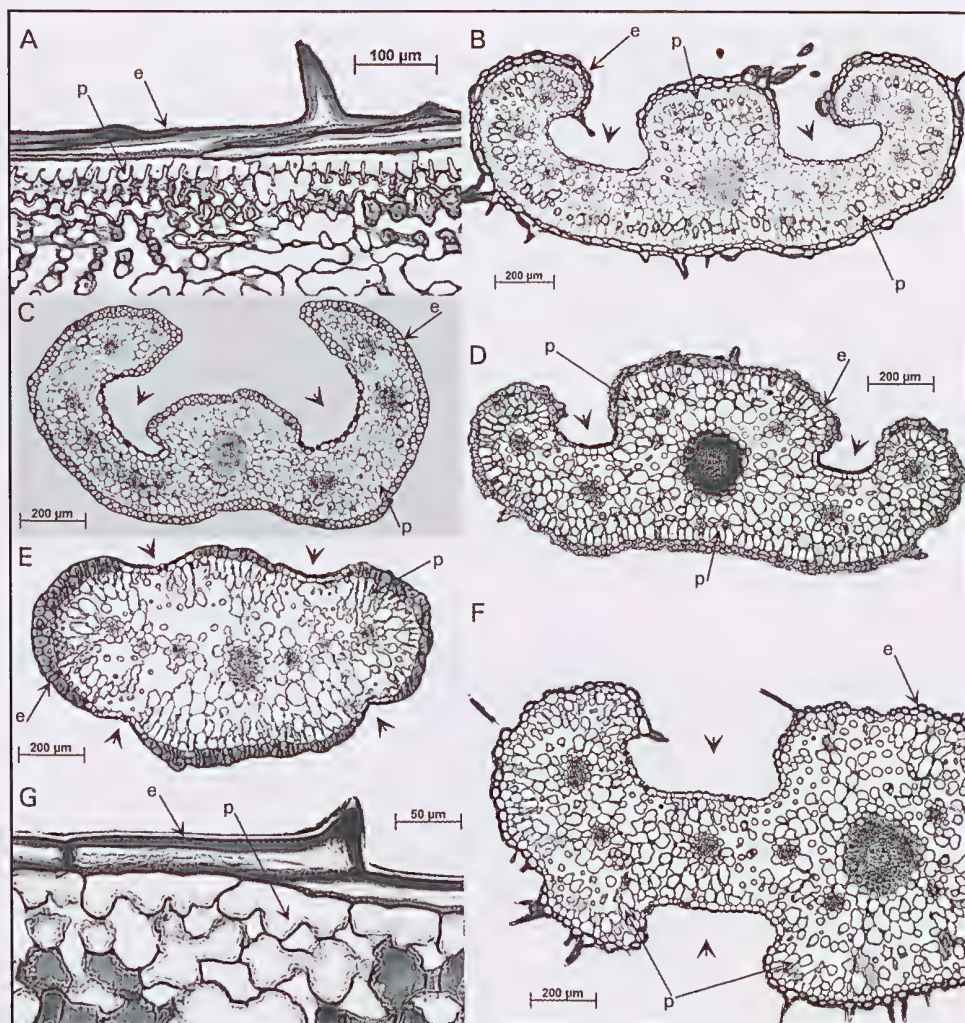


Figure 1. Leaf anatomy in selected members of *Stylidium* subgenus *Tolypangium* section *Squamosae*. A – L.S. of *S. crossocephalum* (JAW 288); B – T.S. of *S. crossocephalum* (JAW 22); C – T.S. of *S. hirsutum* (JAW 165); D – T.S. of *S. pseudohirsutum* (JAW 302); E – T.S. of *S. diplotrichum* (ADC 272); F – partial T.S. of *S. expeditionis* (JAW 697); G – L.S. of *S. expeditionis* (JAW 697), showing a transverse epidermal crosswall to the left and an oblique cross wall to the right. e = epidermis, p = palisade, arrows indicate the position of the stomata.

Taxonomy

***Stylidium diplotrichum* Wege, sp. nov.**

Stylidio pseudohirsuto affini, sed foliis utrinque bisulcatis et corollae lobis anterioribus obtusis.

Typus: Tootbardie Road, SE of Eneabba [precise locality withheld], 24 Oct. 2002, J.A. Wege JAW 730 (*holo*: PERTH 06656358; *iso*: MEL).

Perennial herb 14.5–40 cm high. *Glandular trichomes* 0.1–0.7 mm long; heads red, ellipsoid; stalks translucent. *Eglandular (pilose) trichomes* 1–6.5 mm long. *Stems* short, or somewhat condensed, internodes 0.2–3.1 cm long, glabrous. *Stilt roots* glabrous. *Leaves* arranged in a rosette at the stem apex, linear, 1–11.7 cm long, 0.6–1.2 mm wide, apex mucronate, margin entire; surface scabrous, papillae c. 0.1 mm long, largely confined to midrib on distal portion of leaf; stomata confined to 2 longitudinal grooves on both the adaxial and abaxial surfaces. *Scale-leaves* 0.5–2.5 cm long. *Scape* 12–32.5 cm high, 0.9–1.7 mm wide, glandular and pilose throughout. *Inflorescence* paniculate or almost head-like, 3–10-flowered; inflorescence units 1–5-flowered, 2–8 cm long, upper units flowering first. *Bracts* 8.5–13 mm long, 1–1.8 mm wide; external surface glandular, pilose hairs present or absent; inner surface glandular. *Bracteoles* 2.6–6.8 mm long. *Pedicels* 1–4 mm long, glandular. *Hypanthium* ellipsoid, 3.5–5.5 mm long, 2.5–3.3 mm wide, glandular and pilose. *Calyx lobes* free, 4.8–8.3 mm long, 0.6–1.9 mm wide, glandular, pilose hairs present or absent, inner apex glandular, margin entire, apex subacute. *Corolla* white; abaxial surface speckled purple, glandular; tube 6.5–8.8 mm long; lobes vertically-paired, elliptic, base truncate; anterior lobes cymbiform, occasionally overlapping at apex, 7.5–13.8 mm long, 3.5–8 mm wide, margin glandular on sinus-side; posterior lobes 7.5–13.2 mm long, 4–7.7 mm wide, fused at base. *Labellum* boss white, elliptic, 1–1.6 mm long, 0.6–0.9 mm wide; margin papillose, white with a pink apex, apex 0.5–1.4 mm long; lateral appendages 0.5–1.2 mm long, white with pink tips. *Throat appendages* 4, anterior appendages wing-like and fused at base to a broadly linear posterior tooth; anterior appendages white with a small pink-red patch on the posterior corner, 1.2–2.5 mm long, 1.2–2.5 mm wide; posterior appendages white with pink-red markings near the apex and a yellow tip, 1.5–2.5 mm long. *Column* 11.5–15.3 mm long; anthers greenish, subtending hairs absent; pollen yellow; stigma sessile, bilobed. *Capsule* not viewed. *Seeds* pale orange-brown; broadly ellipsoid to ovoid; 2–2.5 mm long, 1.2–1.6 mm wide. (Figures 2, 3B)

Specimens examined. WESTERN AUSTRALIA: Mount Lesueur [precise locality withheld], 30 Oct. 2002, A. Crawford ADC 272 (CANB, NSW, PERTH); Mount Lesueur, 23 Oct. 1979, E.A. Griffin 2336 (PERTH); 4 km NNW of Mount Lesueur, 6 Nov. 1979, E.A. Griffin 2488 (PERTH).

Distribution. Known only from in the northern sandplains east of Jurien Bay. (Figure 3A)

Habitat. Favours soils with high clay content bearing *Acacia* and Myrtaceous shrubland.

Phenology. Flowering specimens are known from late September to early November.

Conservation status. Conservation Codes for Western Australian Flora: Priority Two. This species is known from only four collections, three of which are from Lesueur National Park. The fourth, the type locality, is from a degraded roadside. Surveys are required in order to document population sizes and establish the geographic range of this species.

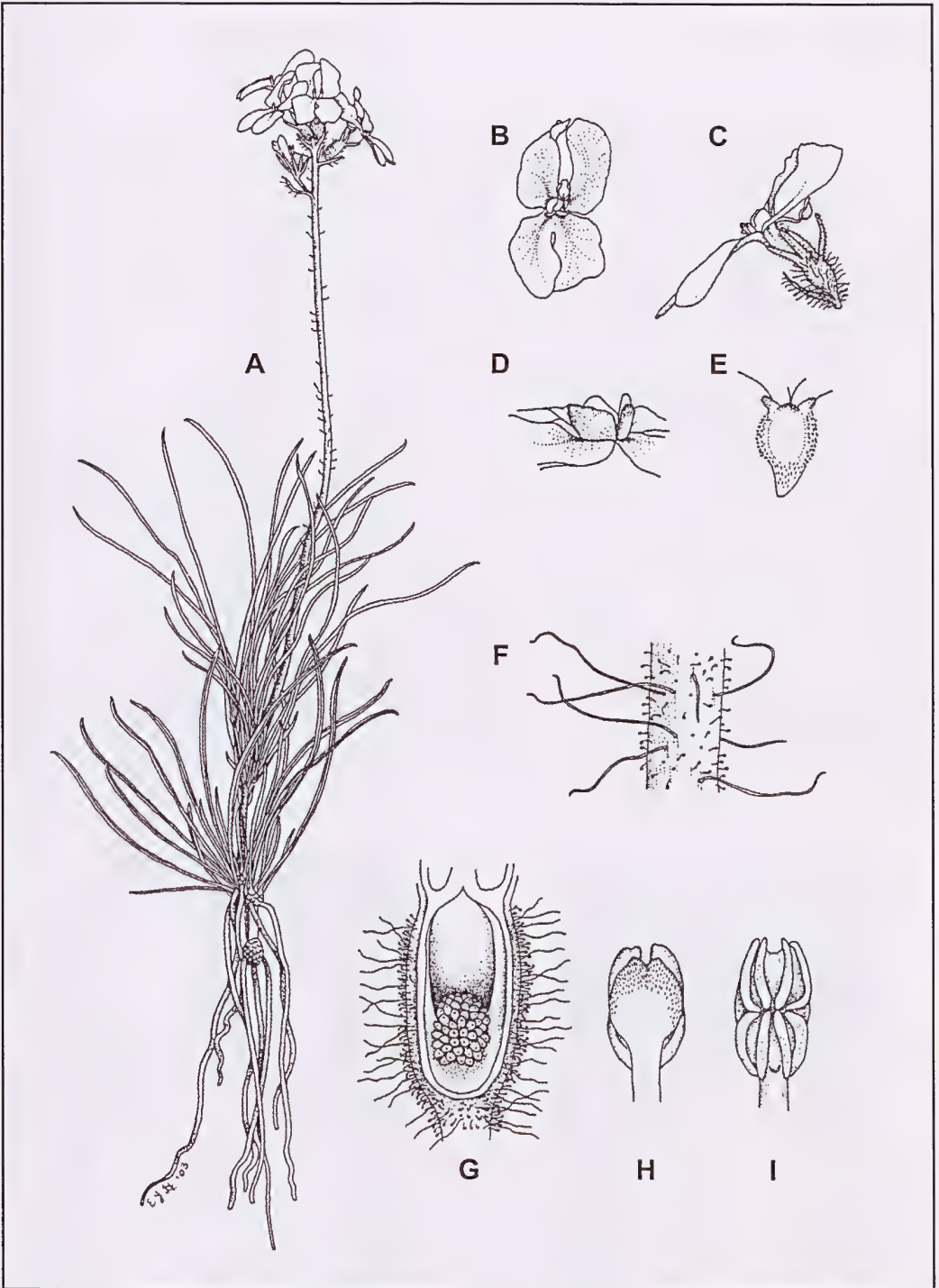


Figure 2. *Stylidium diplotrichum*. A - habit; B - flower; C - side view of flower; D - throat appendages; E - labellum; F - portion of scape showing shorter glandular trichomes and longer, eglandular trichomes; G - L.S. through the hypanthium; H - connective; I - empty anther locules with developing 2-lobed stigma. Drawn from Wege JAW 730.

Etymology. The specific epithet is of Greek origin (*diplois* = two, *thrix* = hair) and refers to the two forms of trichomes (glandular and eglandular) that are present on the inflorescence.

Notes. *Stylidium diplotrichum* closely resembles *S. pseudohirsutum*, with both species possessing a few-flowered inflorescence, short pedicels, glandular and eglandular hairs on the scape, a corolla tube exerted beyond long calyx lobes, and similar throat appendages. Both taxa also have comparable habitat preferences although they are geographically disjunct (Figures 3A, 4A). *Stylidium diplotrichum* can be morphologically differentiated from *S. pseudohirsutum* by the shape of the corolla lobes, particularly the anterior (upper) lobes, which are broad and rounded at the apex (Figure 3B) as opposed to tapered (Figure 4B). Distinguishing features of *S. diplotrichum* that are more readily viewed on herbarium material are the bisulcate leaves that have mucronate rather than subacute apices, and the presence of a glandular tomentum on the inner apex of the floral bracts and calyx lobes.

Stylidium diplotrichum may also be confused with *S. expeditionis* as both species possess bisulcate leaves and a similar inflorescence structure; however, *S. diplotrichum* has both long eglandular and shorter glandular hairs on the scape rather than just the latter, and a glandular tomentum on the inner apex on the floral bracts and calyx lobes (glabrous in *S. expeditionis*). There is a tendency for *S. diplotrichum* to have narrower leaves that are less prominently grooved, and which possess a less dense and shorter indumentum. In addition, the corolla shape in these two taxa is markedly different. (Figures 3B, 5B)

Stylidium diplotrichum shares with *S. hirsutum* a tomentum of eglandular hairs on the scape and hypanthium with; however, *S. hirsutum* lacks glandular hairs along the length of the scape, has shorter calyx lobes, corolla lobes that are typically smaller and pink instead of white, and leaves with stomata restricted to the adaxial surface. The bisulcate leaves of *Stylidium diplotrichum* also distinguish this species from other scale-leaved taxa that grow in the northern sandplain region including *S. crossocephalum*, *S. stenosepalum* E. Pritz. and members of the *S. caricifolium* Lindl. species complex.

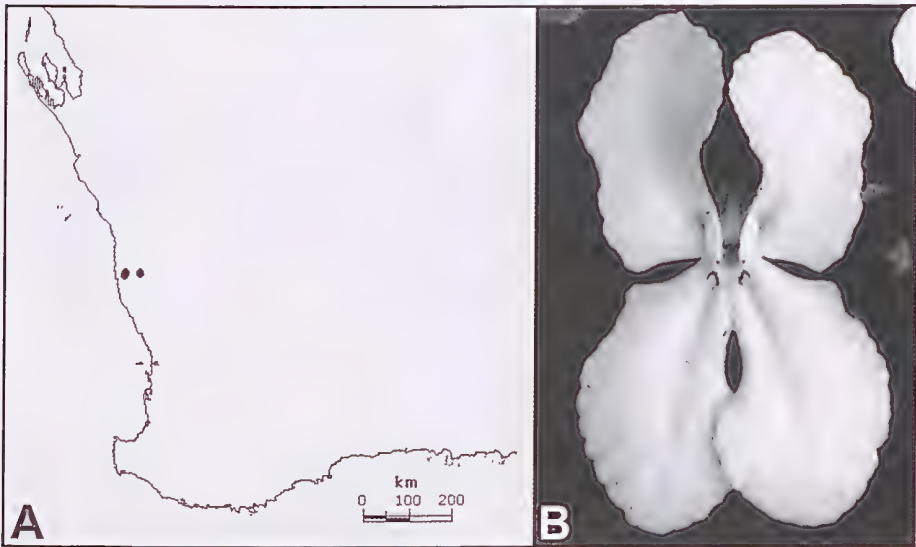


Figure 3. *Stylidium diplotrichum*. A – distribution map; B – flower (Wege JAW 730).

Stylidium pseudohirsutum Mildbr. in A. Engler, Pflanzenreich IV, 278: 76 (1908). *Type*: West-Australien: Ohne Standort [Western Australia], J. Drummond Ser. 5 No. 353 (*lecto*, here designated: W!; *isolecto*: BM! (2 sheets), CGE!, K!, MEL 2156060!, P!).

Illustrations. Mildbraed (1908) Figure 21A–B, p. 75; Carlquist (1969) Figures 98–100 (as photographs), p. 55; Grieve & Blackall (1982) No. 23, p. 737 & Plate IX (photograph).

Perennial herb 9–42 cm high. *Glandular trichomes* 0.2–1 mm long; heads red-black to black, ellipsoid; stalks translucent. *Eglandular (pilose) trichomes* 1–5 mm long. *Stems* somewhat condensed. *Stilt roots* glabrous. *Leaves* arranged in a rosette at the stem apex, linear, 2–16 cm long, 0.6–1.3 mm wide, margin involute, apex subacute; surface scabrous, papillae c. 0.1 mm long, dense to sparse (rarely absent); stomata confined to 2 longitudinal bands on the adaxial surface. *Scale-leaves* 0.5–3.5 cm long. *Scape* 7.5–30 cm high, 0.5–1.2 mm wide, pilose throughout, glandular trichomes sparse to absent on lower half and more common on upper portion. *Inflorescence* unbranched, 1–6-flowered, flowers opening from apex to base. *Bracts* 3.6–8 mm long, 0.9–1 mm wide, external surface glandular and pilose, inner surface glabrous. *Bracteoles* 1.5–3 mm long. *Pedicels* 1.5–6 mm long; glandular, pilose hairs present or absent. *Hypanthium* ellipsoid, 3–6.5 mm long, 1.5–2.8 mm wide, glandular and pilose. *Calyx lobes* free, 3.7–7.5 mm long, 0.8–2.2 mm wide, glandular, pilose hairs present or absent, inner apex glabrous, margin entire, apex subacute. *Corolla* white to creamy-yellow; abaxial surface speckled purplish-brown, glandular; tube 6.5–9 mm long; lobes vertically-paired; anterior lobes lanceolate to falcate, typically cymbiform, 7–18 mm long, 2.5–4.8 mm wide, margin glandular hairy on sinus-side; posterior lobes elliptic to lanceolate, apex subacute to obtuse, 8.7–17 mm long, 4.5–7.3 mm wide, fused at base. *Labellum* boss white to yellow, ovate to elliptic, 1.1–2 mm long, 0.6–0.8 mm wide; margin papillose, irregular, white or yellow and pink-red, apex 0.3–1.3 mm long; lateral appendages 0.6–1.1 mm long, white to yellow with pink-red tips. *Throat appendages* 4, anterior appendages wing-like and fused at base to a broadly linear, entire or bilobed posterior tooth; anterior appendages white, 1.8–2.8 mm long, 1.8–2.5 mm wide; posterior appendages white with pink-red tips, 1.5–2.5 mm long. *Column* 15–18 mm long; anthers greenish, subtending hairs absent or present; pollen yellow; stigma sessile, bilobed. *Capsule* 5.5–7 mm long. Seed not viewed. (Figure 4B)

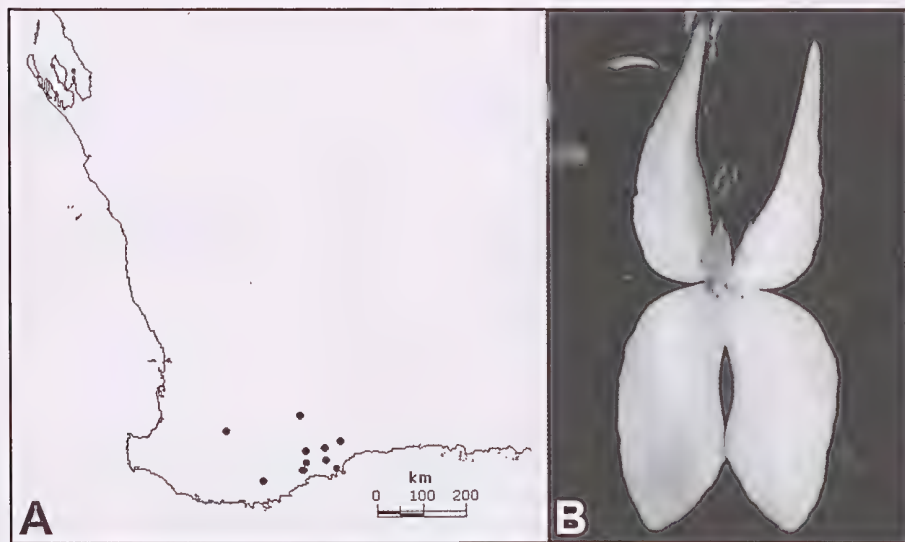


Figure 4. *S. pseudohirsutum*. A – distribution map; B – flower (Wege JAW 1142).

Selected specimens. WESTERN AUSTRALIA: c. 2 miles W of Needilup on Jerramungup–Ongerup Rd, 8 Nov. 1967, *S. Carlquist* 4033 (CANB, MEL, NSW, PERTH, RSA); Shire Reserve No. 800 at Kamballup, 26 Nov. 1986, *D. Coates* 118.1 (PERTH); Hill above S bank Pallinup River, 1 Nov. 1988, *E.J. Croxford* 6251 (PERTH); 5 miles N of Bremer Bay, 28 Nov. 1960, *A.S. George* 1730 (PERTH); Kalgan Plains Reserve, 15 km W of Kamballup, 27 Nov. 1986, *G.J. Keighery & J.J. Alford* 1725 (PERTH); Reserve 1736, Beaufort River flats, 4.9 km N of Robinson Rd on W side of Albany Hwy, 18 Nov. 1999, *B. Loudon* BLO 13 (PERTH); Beaufort River Bridge Reserve, 19 Nov. 1989, *A. Lowrie* 247 (PERTH); 14 miles E of Jerramungup, 10 Nov. 1963, *K.R. Newbey* 1191 (PERTH); 30 km SE of Jerramungup, Fitzgerald River National Park, 12 Nov. 1984, *K.R. Newbey* 10854 (PERTH); 14 km WNW of Mount Drummond, 24 Nov. 1985, *K. Newbey* 11047 (PERTH); 700 m W along Woogenilup Rd from Chester Pass Rd, Kamballup, 17 Nov. 1996, *J.A. Wege, R. Butcher & F. Valton* JAW 302 (PERTH); 150 m W of Murray Rd on Gordon Inlet Rd, near Bremer Bay, 2 Dec. 2003, *J.A. Wege* 1142 (PERTH).

Distribution. Occurs from the Arthur River region south to the Stirling Plains and east to Fitzgerald River National Park. (Figure 4A)

Habitat. Prefers clayey soils in mallee, *Acacia* or Myrtaceous shrublands.

Phenology. Flowering specimens have been recorded from November and December.

Conservation status. Conservation codes for Western Australian Flora: Priority Three. Currently known from a handful of small populations within conservation reserves. Not under immediate threat but further surveys and monitoring are recommended.

Typification. The specimen housed at W is chosen here as the lectotype as it has been annotated by Mildbraed. Mildbraed (1908) did not know the region of Western Australia from which the type collection was made; however, according to Erickson (1969) and in agreement with the currently known range of this species, it was acquired by Drummond somewhere between the Stirling and Mount Barren Ranges.

Chromosome number. Coates (1982) recorded a count of $n = 8$; however no voucher specimen has been located at PERTH or UWA.

Notes. *Stylidium pseudohirsutum* is morphologically similar to *S. diplotrichum*, as discussed in the notes for the latter species.

Stylidium expeditionis Carlquist, *Aliso* 8: 453 (1976). *Type:* Scrubby area at northwestern corner of Tutanning Reserve E of Pingelly, Western Australia, 9 Oct. 1974, *S. Carlquist* 5960 (*holo:* RSA!; *iso:* GH *n.v.*, K (2 sheets)!, MEL!, NSW!, PERTH 1139401!, RSA!, US *n.v.*).

Illustrations. Carlquist (1976) Figures 13–21 (as photographs), pp. 454 & 456; Grieve & Blackall (1982) No. 21d, p. 53 of supplement.

Perennial herb 12–42 cm high. *Glandular trichomes* 0.15–0.6 mm long; heads red-black to black, ellipsoid; stalks translucent to yellowish. *Eglandular (pilose) trichomes* absent. *Stems* short, or somewhat condensed, internodes 0.4–1 cm long, glabrous. *Stilt roots* glabrous. *Leaves* arranged in a rosette at the stem apex, linear, 4.5–12 cm long, 0.7–3 mm wide, margin entire, apex subacute; surface pubescent, papillae 0.2–0.4 mm long; stomata confined to 2 longitudinal grooves on both the adaxial and abaxial surfaces. *Scale-leaves* 0.4–2.5 cm long. *Scape* 11–33 cm high, 0.4–2 mm wide, glandular throughout. *Inflorescence* paniculate, 3–17-flowered; inflorescence units 2–7-flowered, 2–7.5 cm long, upper units

flowering first. Bracts 2.5–8 mm long, 1.2–2 mm wide, external surface glandular, inner surface glabrous. Bracteoles 0.9–2.6 mm long. Pedicels 3–7 mm long; glandular. *Hypanthium* ellipsoid, 3.2–5 mm long, 1.3–3.2 mm wide, glandular. Calyx lobes partly fused (2 fused and 3 free), 2.8–6 mm long, 0.6–1 mm wide, glandular, inner apex glabrous, margin entire, apex subacute. *Corolla* white to pale mauve, yellow–brown in bud, throat white; abaxial surface glandular; tube 6–7 mm long; lobes vertically-paired, spatulate, cymbiform, sometimes overlapping at apex; anterior lobes 8.5–10.5 mm long, 6.2–8.5 mm wide, margin glandular on sinus-side; posterior lobes 6.2–8.5 mm long, 5.5–7.5 mm wide, fused at base. *Labellum* boss white, ovate, 0.7–1.2 mm long, 0.4–0.6 mm wide; margin papillose, white, sometimes tipped purple-black, apex 0.3–0.4 mm long; lateral appendages 0.6–0.8 mm long, white tipped pink. *Throat appendages* 6, white tipped dark pink; anterior appendage wing-like, 1.4–2 mm long, 0.6–0.9 mm wide; posterior appendages tooth-like, entire or fused at base, 0.7–1.2 mm long. *Column* 11–11.5 mm long; anthers red–black, subtending hairs absent; pollen white or yellow; stigma sessile, entire, elliptic. *Capsule* 4–6 mm long. *Seed* not viewed. (Figure 5B)

Selected specimens. WESTERN AUSTRALIA: Highbury State Forest, 20 km S of Narrogin, 26 Oct. 1989, K. Atkins KJA 89013 (PERTH); Highbury State Forest, 20 km S of Narrogin, 26 Oct. 1989, K. Atkins KJA 89014 (PERTH); Tutanning Reserve, SE of Pingelly, 16 Nov. 1965, A.S. George 7356 (PERTH); Property of Bruce Mitchell, N side of Dongolocking Rd, 30 Oct. 1991, F.H. & M.P. Mollemans 4617 (PERTH); Highbury Block State Forest 52, N of Forestry Rd, 15 Oct. 1999, C. Taylor, P. Rose & G. Warren 377 (PERTH); Coleman Block, Highbury Forest, 19 Sept. 1999, G. Warren, C. Taylor & P. Rose 432 (PERTH); Jarrah Road, Tutanning Reserve 21 Oct. 2002, J.A. Wege JAW 697 (PERTH).

Distribution. Currently known from several disjunct populations in the Avon region, from north-west of Dumbleyung to Tutanning Reserve and south to Highbury. (Figure 5A)

Habitat. Favours gravelly yellow-brown sandy loam or white sand over laterite in Proteaceous and Myrtaceous scrub/heath.

Phenology. Flowers have been recorded from September to November.

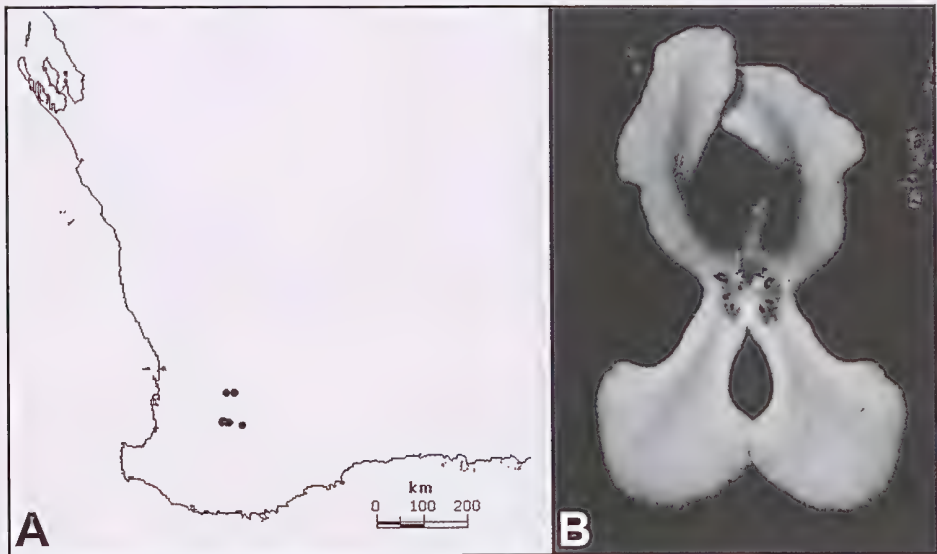


Figure 5. *S. expeditionis*. A – distribution map; B – flower (Wege JAW 697).

Conservation status. Conservation codes for Western Australian Flora: Priority Four. This species is only known from a handful of populations across 3 disjunct regions. Not immediately under threat.

Chromosome number. James (1979) recorded a count of $n = 8$ from a population within Tutanning Reserve. No voucher specimen has been located at either PERTH or UWA.

Notes. With its spatulate, subequal corolla lobes, *Stylidium expeditionis* has a distinctive corolla outline (Figure 5B). It is also readily distinguishable from *S. pseudohirsutum*, *S. hirsutum* and *S. crosssocephalum* by its bisulcate leaves, and lack of eglandular hairs on any part of the inflorescence. Differences to *S. diplotrichum* are discussed under the notes for that species.

Stylidium crosssocephalum F.Muell., *Fragm. Phyt. Austral.* 6: 5 (1868). Base name for *Candollea crosssocephala* (F.Muell.) F.Muell. *Syst. Census Austral. Pl.* 85 (1882). *Type:* In Australia occidentali [Western Australia], *J. Drummonds.n.* (*lecto*, here designated: MEL 2156184!; *isolecto*: K 000060263!, MEL 2156185!).

Illustrations. Mueller (1892); Erickson (1958) Plate 47, Nos. 11-19, p. 156; Grieve & Blackall (1982) Frontispiece & No. 18, p. 735.

Perennial herb 8–36 cm high. *Glandular trichomes* 0.3–1.5 mm long; heads red-black, ellipsoid; stalks translucent. *Eglandular (pilose) trichomes* 0.7–4 mm long. *Stems* short, internodes 0.2–6 cm long, glabrous. *Stilt roots* scabrous. *Leaves* arranged in a rosette at the stem apex, linear, 1.5–13.5 cm long, 0.6–2.3 mm wide, apex mucronate, margin involute; surface scabrous, papillae 0.1–0.6 mm long; stomata confined to 2 longitudinal bands on the upper surface. *Scale-leaves* 0.5–3.2 cm long. *Scape* 5–40 cm high, 0.5–2.7 mm wide, glabrous. *Inflorescence* unbranched, head-like, 10–c. 18-flowered, flowers opening from apex to base. *Bracts* 9.5–19 mm long, 2.8–5.4 mm wide, external surface scabrous, inner surface glabrous or scabrous. *Bracteoles* 8–11.5 mm long. *Pedicels* 1–5 mm long, glabrous. *Hypanthium* obloid to ellipsoid, 3–4.5 mm long, 1.7–2.9 mm wide, pilose on upper half. *Calyx lobes* partly fused (2 fused and 3 free), unequal in length (with two much larger than the remaining three), 6.3–11 mm long, 1.6–2.6 mm wide, scabrous, inner apex glabrous, margin hyaline, apex mucronate. *Corolla* white (rarely pale pink), throat markings pink-red; abaxial surface glandular; tube 6–7.5 mm long; lobes vertically-paired; anterior lobes narrowly ovate, curved inward and cymbiform, sometimes overlapping at apex; 8.2–11.2 mm long, 3.6–4.7 mm wide; posterior lobes elliptic to oblong, apex obtuse, 7.5–10.3 mm long, 3–4.7 mm wide, fused at base. *Labellum* boss orbicular, 0.7–1.1 mm long, 0.7–0.9 mm wide; margin entire; terminal appendage white, 2.4–3.6 mm long; lateral appendages absent, or present, 0.1–0.5 mm long. *Throat appendages* 6, anterior appendage wing-like, white or white with red-pink to purplish markings, 3.1–5.2 mm long, 1–1.6 mm wide; posterior appendages subulate, white tipped red-pink to purplish, 0.8–2.3 mm long. *Column* 12–15.6 mm long; anthers yellow to greenish, subtending hairs absent; pollen yellow, stigma shortly stalked, entire, circular. *Capsule* 4.8–6 mm long. *Seeds* pale orange-brown, ellipsoid, 1.6–2.2 mm long, 0.6–0.7 mm wide. (Figure 6B)

Selected specimens. WESTERN AUSTRALIA: Between 35–36 miles E of Geraldton, 27 Aug. 1974, *S. Carlquist* 5447 (PERTH, RSA); 38 km S of the Geraldton Hwy turnoff on the Eneabba Rd, 28 Sept. 1976, *R.J. Chinnock* 3196 (AD, PERTH); Near Eneabba, c. 35 miles SW of Three Springs, 28 Aug. 1970, *R. Coveny* 3083 (NSW, PERTH); Intersection of Tomkins and Natta Rds, 39 km due NNE of Eneabba, 10 Sept. 1985, *J. D'alonzo* 197 (CANB, PERTH); Victoria District, Greenough River, Sept. 1901, *Diels & Pritzel* 520 (PERTH); Yanchep National Park, Yeal Swamp Rd, 4.5 km ENE from junction with Wanneroo Rd, 1 Oct. 1988, *J.M. Fox* 88/053 (CANB, PERTH); Salt Lake Rd, Shire of Dandaragan, 10 Oct. 2001, *F. & J. Hort* 1477 (PERTH); 11.5 km E of Jurien, 26 Sept. 1976, *R.W. Johnson* 3245 (BRI, PERTH); W boundary

of Watheroo National Park, 6 Oct. 1971, *R.D. Royce* 9639 (PERTH); 2.5 km along Mogumber West Rd from Brand Hwy, 9 Oct. 1995, *J.A. Wege & K.A. Shepherd* JAW 22 (MEL, PERTH); Sandtrack E of Brand Hwy at 3.1 km N of Rocky Springs Rd, South Eneabba Nature Reserve, 14 Sept. 1996, *J.A. Wege & K.A. Shepherd* JAW 207 (PERTH); 6.75 km W along Wongonderrah Rd from Brand Hwy, SSE of Cervantes, 21 Oct. 1997, *J.A. Wege* 398 (PERTH); 6.6 km E on Mount Adams Rd from Brand Hwy, 29 Sept. 2002, *J.A. Wege & C. Wilkins* JAW 615 (PERTH); c. 9 km S of Eneabba on Brand Hwy, 27 Sept. 2002, *J.A. Wege & C. Wilkins* JAW 634 (PERTH).

Distribution. A widespread species of the northern sandplains, occurring from the Geraldton area to just north of Perth. (Figure 6A)

Habitat. Grows on sandy soils over laterite or limestone, in heathland, *Banksia* low woodland and *Eucalyptus* shrubland.

Phenology. Flowers have been recorded from August to early November.

Conservation status. This species is common throughout the northern sandplain region; no conservation code applies.

Chromosome number. James (1979) recorded a count of $n = 7$ from populations 43 miles north of Perth (PERTH02943441; PERTH02943433) and 15 miles south of Lancelin (PERTH02943425). Coates & James (1979) reported the same count from 69 collection sites between Yanchep and Geraldton, although no voucher specimens from this study have been located at PERTH or UWA. The same study also documented extensive karyotype variation within and between populations of *S. crossocephalum*.

Notes. *Stylidium crossocephalum* can be distinguished from all other scale-leaved trigger plants by its glabrous scapes, scarious floral bract margins, and striking throat markings. (Figure 6B)

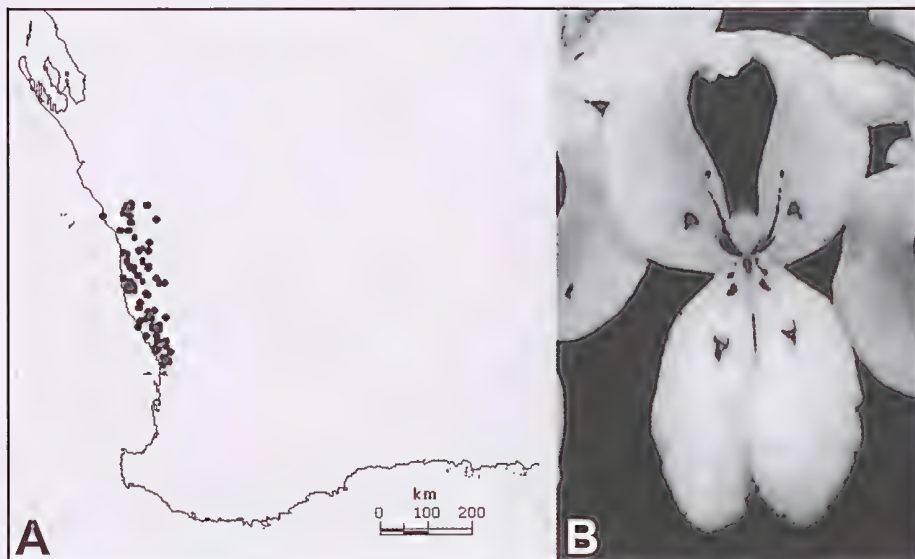


Figure 6. *S. crossocephalum*. A – distribution map; B – flower (*Wege* JAW 596).

Stylidium crosssocephalum exhibits considerable variation in flower size both within and between populations. Subtle differences in the shape of the corolla and throat appendages, and the throat marking pattern also occur. This variation is in accordance with that often shown in species of *Stylidium* both within and between populations and is not considered here to be taxonomically significant.

Stylidium hirsutum R.Br., Prodr. 568 (1810). Base name for *Candollea hirsuta* (R.Br.) F. Muell., Syst. Census Austral. Pl. 85 (1882). Type: King George Sound, 9 Dec. 1801, R. Brown Bennett No. 2676 (*lecto*, here designated: BM!; *isolecto*: BM!, CANB!, K!, K 000060258!, MEL 2156094!, P!).

Illustrations. Graham (1832) Tab. 3194; Mildbraed (1908) Figure 21G-J, p. 75; Erickson (1958) Plate 46, No. 1 and Plate 47, Nos. 1-10, p. 156; Grieve & Blackall (1982) No. 26, p. 738 and Plate IX, photograph; Wheeler *et al.* (2002) p. 915.

Perennial herb 12–57 cm high. *Glandular trichomes* 0.2–1.6 mm long; heads red-black to black, ellipsoid; stalks translucent. *Eglandular (pilose) trichomes* 0.7–6 mm long. *Stems* somewhat condensed. *Stilt roots* glabrous. *Leaves* arranged in a rosette at the stem apex, linear, 2.5–50 cm long, 0.5–3 mm wide, apex mucronate, margin involute; surface glabrous to scabrous, papillae 0.1 mm long; stomata confined to 2 longitudinal bands on the adaxial surface. *Scale-leaves* 0.5–1.1 cm long. *Scape* 11–54 cm high, 0.5–3 mm wide, pilose (dense at base, sparser towards apex), glandular trichomes absent or present on upper inflorescence axis only (rarely just below start of inflorescence). *Inflorescence* unbranched, head-like, 3–c.26-flowered, flowers opening from apex to base. *Bracts* 3–8 mm long, 0.3–1.6 mm wide; external surface pilose, glandular trichomes absent or present at base; inner surface glabrous. *Bracteoles* 1–3.2 mm long. *Pedicels* 1–6 mm long, pilose. *Hypanthium* ellipsoid, 2–5.2 mm long, 1.1–2.8 mm wide, glandular, pilose hairs present or absent. *Calyx lobes* free or partly fused (2 fused and 3 free), 2.4–4.3 mm long, 0.5–1.3 mm wide, glandular, pilose hairs present or absent, inner apex glabrous, margin entire; apex subacute. *Corolla* bright pink (rarely pale pink), throat white or yellow; abaxial surface glandular; tube 2–3.9 mm long; lobes vertically-paired, elliptic to obovate, apex obtuse; anterior lobes 3.5–8 mm long, 1.5–4 mm wide, margin glandular on sinus-side; posterior lobes 4.2–9 mm long, 2.5–5.1 mm wide, fused at base. *Labellum* boss white to yellowish, ovate to elliptic, 0.6–1.3 mm long, 0.4–0.8 mm wide; margin papillose, bright pink, apex 0.3–0.7 mm long; lateral appendages 0.5–1.3 mm long, bright pink, or pale pink with bright pink tips. *Throat appendages* 6; anterior appendage wing-like, white at base, pink above, 1.4–3.7 mm long, 0.8–1.5 mm wide; posterior appendages mound-like or tooth-like (bilobed, rarely trilobed), white to yellow or pale pink with bright pink tips, 0.1–2 mm long. *Column* 9–12.5 mm long; anthers greenish, subtending hairs translucent or red; pollen white to greenish yellow; stigma sessile, entire, ovate to elliptic. *Capsule* 3.5–7.5 mm long. *Seeds* yellow to pale orange-brown, ellipsoid, 0.65–0.9 mm long, 0.3–0.5 mm wide. (Figure 7B)

Selected specimens. WESTERN AUSTRALIA: Near Yorn Creek, on Yellanup Rd at Narrikup, 24 Oct. 1973, A.M. Ashby 4358B (AD, PERTH, RSA); Birdwhistle Nature Reserve, 9 July 1998, E. Bennett & A. Paton BS 9.23 (PERTH); Mount Barker-Porongurup Rd, at a point roughly N of the E end of the Porongurups, 1 Nov. 1967, S. Carlquist 3969 (AD, CANB, MEL, NSW, PERTH, RSA); Private property S of Coalfields Rd, W of Clarke Rd, 10 km WSW of Arthur River, 7 Nov. 1999, V. Crowley DKN 992 (PERTH); Kendenup, N of Mount Barker River, 17 Oct. 1951, R. Erickson s.n. (PERTH); West Mount Barren, 29 Nov. 1960, A.S. George 1825 (PERTH); W from Border Rd towards Cranbrook on N side of Stirlings, Oct. 1971, S. James 71.10/92 (PERTH); Near turnoff to Natural Bridge, Torndirrup National Park, 20 km S Albany, 4 Dec. 1986, G.J. Keighery 8572 (CANB, PERTH); 6.8 km E of Basil Rd turnoff on Cape Riche Rd, 15 Nov. 1995, T.R. Lally & B.J. Lepschi 896 (PERTH); Benn Reserve, 1 km NW of Kojonup, 14 Nov. 1999, C.M. Lewis 462 (PERTH); Ridge between Mount Gardner and False Island, Two Peoples Bay Nature Reserve, 12 Nov. 1992, C.J. Robinson 1005 (PERTH); Dryandra State Forest, 13 Nov. 1987,

D.M. Rose 493 (CANB, PERTH); SE corner of Camel Lake Nature Reserve, 4.4 km W of Formby South Rd on Salt River Rd, 27 Oct. 1998, *L.W. Sage & F. Obbens* LWS 1047 (PERTH); Reserve A21064, c. 15 km directly NE of Arthur River townsite, 28 Oct. 1998, *L.W. Sage & F. Obbens* LWS 1082 (PERTH); 2.2 km along Bluff Knoll Rd from Chester Pass Rd, Stirling Range National Park, 16 Nov. 1996, *J.A. Wege, R. Butcher & F. Valton* JAW 295 (PERTH); 400 m along Ranger's Dam track, corner Chester Pass Rd and Knoll Rd, Stirling Range National Park, 17 Nov. 1996, *J.A. Wege, R. Butcher & F. Valton* JAW 298 (PERTH); Mount Lindesay walk trail, 12 Nov. 2002, *J.A. Wege* JAW 819 (PERTH); 400 m SE on Yeriminup Rd from Frankland–Cranbrook Rd, 13 Nov. 2002, *J.A. Wege* JAW 828 (PERTH); Wandering Timber Reserve, Wandering, 13 Nov. 2002, *J.A. Wege* JAW 832 (PERTH); Albany windfarm, off Sandpatch Rd, 8 Dec. 2002, *J.A. Wege* JAW 840 (PERTH); Just E of Mount Many peaks, 9 Nov. 1974, *D.J.E. Whibley* 5202 (AD, PERTH).

Distribution. Known from the western end of Fitzgerald River National Park west to the Denmark region, and north to Wandering. (Figure 7A)

Habitat. Grows on limestone or granite-derived soils in heathland, *Agonis* or mallee shrubland, or open woodland.

Phenology. Flowers have been collected from mid-October to mid-December, with an isolated record from July.

Conservation status. This species is widespread and not threatened; no conservation code applies.

Chromosome number. James (1979) recorded a count of $n = 8$ from a population on the north side of the Stirling Range (PERTH 02947293). Coates (1982) obtained the same count from populations in the same vicinity; however, no voucher specimens have been located at either PERTH or UWA. He found these populations to be karyotypically similar. It would be of interest to obtain karyotypes for the southernmost and northernmost populations to ascertain whether there are any differences over the current known geographic range of this species.

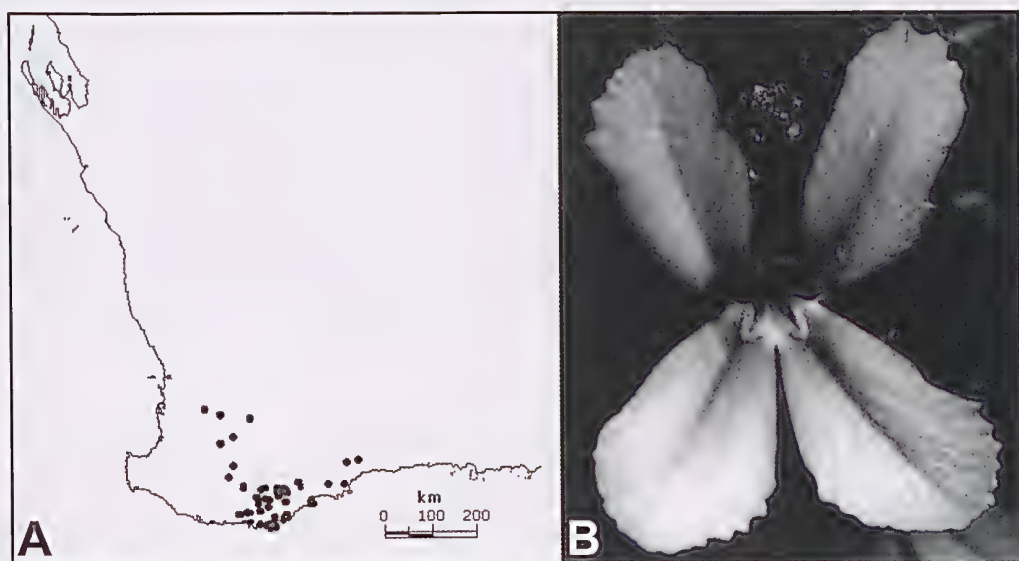


Figure 7. *S. hirsutum*. A – distribution map; B – flower (*Wege* JAW 840).

Notes. The dense, head-like and hirsute inflorescence of pink, vertically-paired flowers makes *Stylidium hirsutum* a readily identifiable scale-leaved trigger plant.

Whilst the leaves in *S. hirsutum* are typically glabrous, there are a number of populations in which they are somewhat scabrid. This character is not considered to be taxonomically significant here since these scabrid-leaved populations occur throughout the geographic range of this species. Further, there appears to be intraspecific variation in this character; in some cases this includes variation on the same individual (with older leaves appearing glabrous, and younger leaves scabrid).

A considerable amount of variation in overall plant size and flower size was also found both within and between populations of *S. hirsutum*. Differences in the size and shape of the throat appendages were also observed during examination of wet collections. The appendages on each posterior corolla lobe are usually reduced to a pair of small (0.1–0.2 mm high) mounds that may appear fused at one end. This appendage form was found consistently in JAW 840 (Albany; Figure 7B) and was observed in some plants from the following variable populations: JAW 295 and JAW 298 (Stirling Ranges), JAW 819 (Mount Lindesay), JAW 828 (Yeriminup) and JAW 832 (Wandering). The posterior appendages in the variable populations sometimes possess small (0.3–1.3 mm high) entire or bilobed (rarely trilobed) tooth-like projections. These projections are quite prominent (to 2 mm high) in some individuals from the Wandering population. This throat appendage variation is not considered taxonomically significant since species of *Stylidium* often display subtle morphological variation in their floral features within and between populations. Raulings & Ladiges (2001) observed this in their research on the eastern Australian *S. graminifolium* complex and the present author has noted it in a broad spectrum of species from the south-west of Western Australia.

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Reinstatement of *Stylidium rigidulum* (Stylidiaceae), with notes on the morphologically allied *S. kalbarriense*

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Abstract

Wege, J.A. Reinstatement of *Stylidium rigidulum* (Stylidiaceae), with notes on the morphologically allied *S. kalbarriense*. *Nuytsia* 16(1): 199–206 (2006). *Stylidium macrocarpum* (Benth.) F.L.Erickson & J.H.Willis and *S. leptophyllum* DC. var. *glabrescens* Mildbr. are placed into synonymy under *S. rigidulum* Sond. and a revised taxonomic description provided. A modified description is also provided for the morphologically allied *S. kalbarriense* Lowrie & Kenneally. A chromosome number of $n = 13$ is reported for *S. kalbarriense*, and a count of $n = 11$ confirmed for *S. rigidulum*. These species are noted to grow in sympatry east of Dongara. Both taxa are susceptible to infection by the rust *Puccinia stylidii* McAlpine.

Introduction

Stylidium rigidulum Sond. was described by Sonder (1845) as part of his revision of the genus for Lehmann's *Plantae Preissianae*; however, this epithet is notably absent from the most recent treatment of the genus, that of Mildbraed (1908). Type fragments of *S. rigidulum* housed at MEL were found by the present author to match that of the later-named *S. macrocarpum* (Benth.) F.L.Erickson & J.H.Willis. This paper serves to place *S. macrocarpum* into synonymy under *S. rigidulum* and to provide a revised species description. A revised description and chromosome data are also provided for the morphologically allied *S. kalbarriense* Lowrie & Kenneally.

Stylidium rigidulum and *S. kalbarriense* are endemic to the northern sandplains of south-west Western Australia. Both species are characterised by linear to narrowly oblanceolate leaves arranged in a basal rosette, glabrous lower scapes, a linear hypanthium, and white to pale pink laterally-paired corolla lobes with red/pink throat markings, no throat appendages and a prominent red/pink to maroon abaxial stripe.

Materials and methods

This study is based on herbarium specimens housed at AD, CANB, CGE, K, MEL, P, PERTH, RSA and W, and on the field observations of the author. Morphological characters were coded using a combination of fresh, spirit and herbarium material. Corolla lobe measurements were based solely on material preserved in 70% ethanol.

Buds from *Wege* JAW 317 were fixed in 3:1 absolute ethanol:glacial acetic acid for 24 hours, rinsed in 70% ethanol and subsequently stained with alcoholic hydrochloric acid carmine (Snow 1963). Three separate counts were obtained from pollen mother cell meiotic material using the squash technique. Photographs were taken using a Zeiss Axiophot microscope and images captured using 6ASA imagelink film.

Data were recorded as a DELTA dataset (Dallwitz *et al.* 1993), from which species descriptions were generated. The species distribution map was generated using NatureMap, a departmental mapping application, and is based on PERTH specimen data.

Taxonomy

Stylidium rigidulum Sond. in C. Lehmann, Pl. Preiss. 1: 389 (1845). *Type*: In regionibus interioribus Australiae meridionali-occidentalis, *Preiss s.n.*, Oct. 1840 (*holo*: MEL 2160214!).

Stylidium streptocarpum Sond. var. ?*macrocarpum* Benth. Fl. Austral. 4: 28 (1868). *Stylidium macrocarpum* (Benth.) F.L.Erickson & J.H.Willis *Victorian Naturalist* 72: 135 (1956). *Type*: Swan River, J. Drummond 2nd Collection No. 271 (*lecto*: MEL 2069479!; *isolecto*: BM!, CGE!, K (2 sheets)!, P!, W!). Swan River, J. Drummond 131 (*paralecto*: K!, MEL 2156087!). Murchison River, *Oldfields.n.* (*paralecto*: K 60853!, MEL 21560801!). Swan River, *Collies.n.* (*paralecto*: K).

Stylidium leptophyllum DC. var. *glabrescens* Mildbr. in A. Engler, Pflanzenreich IV, 278: 91 (1908). *Type*: West-Australien: Ohne Standortsangabe, *Oldfields.n.* (*lecto*, here designated: W!). Victoria, Greenough River Crossing bei Mullewa in lichtem Gebüsch auf Sandboden, *Diels* 6067, Sept. 1901 (*paralecto*: B, n.v., destroyed in WWII).

Illustrations. Erickson & Willis (1956) Plate IV, Figures 8–18, p. 132; Erickson (1958) Plate 42, Figures 1–9, p. 145; Grieve & Blackall (1982) No. 73, p. 754.

Perennial herb, 6.5–30 cm high. *Glandular trichomes* 0.15–0.4 mm long; heads red to red-black, ellipsoid; stalks translucent. *Stems* propped above the soil surface by stilt roots, shortly elongated or somewhat condensed. *Leaves* arranged in a basal rosette, linear to linear-oblongate, 1–6 cm long, 0.5–1.5 mm wide, subterete, glabrous (rarely scabrous); margin entire, or hyaline and serrulate, serrations often conspicuous at leaf apex only; apex mucronate, mucro 0.2–1 mm long. *Scape* 4.5–28 cm high, 0.3–1.2 mm wide, glabrous. Inflorescence paniculate, 3–60-flowered; inflorescence units cymose, 1.5–6.5 cm long, 2–23-flowered, glabrous or sparingly glandular. Bracts 1.5–9 mm long, 0.8–1.2 mm wide, glabrous. Bracteoles 0.8–4 mm long, glabrous. Pedicels ± absent. *Hypanthium* cylindrical, 4.5–17 mm long, 0.4–1.2 mm wide, compressed in T.S., glandular (hairs typically restricted to the upper half). *Calyx lobes* partly fused (2 fused, 3 free) or rarely free, 1.3–2.5 mm long, 0.5–0.7 mm wide, glabrous, margin entire, apex obtuse. *Corolla* white to apricot–pink, throat markings red, throat yellowish; abaxial surface striped red–maroon, glandular; tube 1.2–2 mm long; lobes laterally-paired, elliptic; anterior lobes 3–4.7 mm long, 1.9–2.7 mm wide; posterior lobes 3.8–5 mm long, 1.9–2.7 mm wide. *Labellum* boss yellow, orbicular, 0.45–0.8 mm long, 0.4–0.8 mm wide; margin papillose, red; lateral appendages 0.3–0.6 mm long, yellow to red. *Throat appendages* absent. *Column* 8.7–10.2 mm long; anthers yellow or red, subtending hairs translucent; pollen yellow; stigma sessile, cushion-like, entire (lower lobe fails to develop). *Capsule* 14–25 mm long; broad at base, tapered at apex and partially twisted. *Seeds* rust-coloured, ellipsoid to ovoid, 0.6–1.1 mm long, 0.2–0.5 mm wide, papillose.

Selected specimens examined. WESTERNAUSTRALIA: N of Claremont [Perth], Sept. 1902, *C. Andrews s.n.* (K, PERTH); Yanchep National Park, 55.2 km from Perth toward Lancelin, 5 Oct. 1968, *E.M. Canning* WA/683947 (CANB, L, PERTH); 38 km S of the Geraldton Hwy turnoff on the Eneabba Rd, 28 Sept. 1976, *R.J. Chinmook* 3199 (AD, PERTH); c. 9 miles S of Yanchep, 3 Nov. 1953, *R. Erickson s.n.* (PERTH); Farm, NE of Badgingarra Rd, NW of Dandaragan, 22 Sept. 1988, *E.A. Griffin* 5207B (PERTH); Melaleuca Park, W of Bullsbrook, 27 Oct. 1997, *M. Hislop* 976A (PERTH); Boonanarring Nature Reserve, Gingin, 8 Oct. 2001, *F. Hort* 1492 (PERTH); 0.3 km N along Sandy Point Rd from intersection with Jurien Rd, 9 Oct. 1985, *N. Hoyle* 749 (CANB, PERTH); S side of Hill River Bridge on road 9.5 m E Jurien Bay, S to Cadda, Oct. 1971, *S. James* 71.10/31 (PERTH); Wongan Hills Experimental Farm, Reserve 18672, Craig Rd, 11 Oct. 1985, *C.M. Parker & P.J. Poli* 351 (PERTH); Burma Road Nature Reserve, 22 Sept. 1999, *S. Patrick* 3249A (PERTH); 4.8 km N on Cockleshell Gully Rd from Jurien East Rd, 8 Oct. 2003, *J.A. Wege* JAW 920 (PERTH); N of Arrowsmith River on Brand Hwy, 8 Oct. 2003, *J.A. Wege* JAW 929 (PERTH); 6.5 km E on Mt Adams Rd from Brand Hwy, 8 Oct. 2003, *J.A. Wege* JAW 931 (PERTH); Between Badgingarra and Jurien Bay, 8 Oct. 1969, *D.J.E. Whibley* 3195 (AD, PERTH).

Distribution. Known from the Perth region north to the Geraldton vicinity. Two specimens from an outlier population at Wongan Hills (*C.M. Parker & P.J. Poli* 351 and *C.M. Parker* 274) appear comparable to *S. rigidulum*; however, this population has not been assessed in the field. (Figure 1B)

Habitat. Grows on sand in heath communities, *Banksia* woodland and *Eucalyptus* shrubland.

Phenology. Flowering specimens are known from September to early November.

Conservation status. Widespread and not considered to be under threat.

Typification. The holotype of *Stylidium rigidulum* housed at MEL comprises leaf portions, an inflorescence unit, dissected flower parts and capsules. Despite the poor quality of the specimen, it is readily matched to *S. macrocarpum* by the highly diagnostic capsules that are long (c. 18–22 mm in the type), narrowed at the apex, and partially twisted (Figure 1A). These capsules superficially resemble the beaked hypanthium present in members of *Stylidium* subgenus *Nitrangium* (Endl.) Mildbr. section *Rhynchangium* Benth., which perhaps explains why Sonder positioned his description of *S. rigidulum* between species from this section.

Sonder's type description of *S. rigidulum* can also be matched to *S. macrocarpum*. It was on the basis of this description that Bentham (1868: 28) suggested *S. rigidulum* may be a small form of *S. streptocarpum* Sond. *Stylidium streptocarpum* var. ?*macrocarpum* Benth. was later raised to species level by Erickson & Willis (1956).

The precise type locality of *S. rigidulum* is unclear. Preiss was established in Albany by October of 1840 (McGillivray 1975), well south of the known range of this taxon. There are many inconsistencies with Preiss's label information during October and November of that year and it is likely that the type material of *S. rigidulum* was received by Preiss from another collector (N. Marchant pers. comm.). The MEL sheet of *S. rigidulum* has been annotated by Sonder. No duplicate material has been located.

Type material of *S. leptophyllum* DC. var. *glabrescens* Mildbr. matches *S. rigidulum*. Erickson & Willis (1956) incorrectly postulated that this variety may be equivalent to *S. macrocarpum* var. *planifolium* Erickson & Willis (now known as *S. ricae* Carlquist). The specimen of *S. leptophyllum* var. *glabrescens* housed at W has been annotated by Mildbraed and has therefore been chosen as the

lectotype. Material that he may have studied at Berlin was destroyed during World War II (Botanical Museum Berlin-Dahlem 1999).

Notes. Juvenile leaves of *S. rigidulum* possess a conspicuous hyaline serrate margin and abaxial midrib; however, in mature leaves, the serrations tend to be restricted to the apex of the leaf, or may be absent altogether. In populations south-east of Geraldton (at the northern end of the range for *S. rigidulum*) the serrate margin borders all of the mature leaf, and papillae occur on the midrib area (e.g. *S. Patrick* 3249A, *JAW* 931). I initially thought that these northern populations may represent a new infraspecific taxon; however, there are a few examples of populations to the south that also possess these features (albeit not with the same prominence as the northern populations). Variation in the presence of leaf papillae is known to occur in other species of *Stylidium* (e.g. *S. hirsutum* R.Br.) and the taxonomic significance of this character must be carefully evaluated. Since additional morphological features separating the northernmost populations from the remaining populations could not be found, a separate taxonomic status is not thought warranted.

Stylidium kalbarriense Lowrie & Kenneally. *Nuytsia* 11: 189 (1997). *Type*: 20 km E of Kalbarri, on Ajana–Kalbarri Rd, S side of road, Western Australia, 4 Sept. 1992, A. Lowrie 638 (*holo*: PERTH 04452445!; *iso*: MEL!).

Illustrations. Lowrie & Kenneally (1997), Figure 3, p. 190.

Perennial herb, 6–28 cm high. *Glandular trichomes* 0.15–0.4 mm long; heads red, ellipsoid; stalks translucent to reddish. *Stems* typically positioned just below the soil surface, condensed and slightly thickened (rarely shortly elongated). *Leaves* arranged in a basal rosette, linear to linear-oblongate, 0.8–9.5 cm long, 0.7–1.5 mm wide, subterete, glabrous; margin entire along leaf length, hyaline serrations present at apex and typically along the apical abaxial midrib; apex mucronate, mucro 0.2–1.2 mm long. *Scapes* 5–27 cm high, 0.3–1.5 mm wide, glabrous at base, glandular along inflorescence axis. Inflorescence paniculate, 9–c.50-flowered; inflorescence units cymose, 1.5–9 cm long, 2–13-flowered, glandular. Bracts 1.8–6 mm long, 1.2–1.5 mm wide, glabrous. Bracteoles 1.2–2 mm long, glabrous. Pedicels ± absent, or 0.5–1 mm long, glandular. *Hypanthium* oblong to cylindrical, 3–11 mm long, 0.5–1.3 mm wide, compressed in T.S., glandular. *Calyx lobes* free or partly fused (2 fused and 3 free), 1.5–2.8 mm long, 0.5–1.2 mm wide, glandular, margin entire, apex obtuse. *Corolla* white to pale pink, throat markings red, throat yellowish; abaxial surface striped red–maroon, glandular; tube 1.5–2.5 mm long; lobes laterally-paired, elliptic; anterior lobes 2.3–4.5 mm long, 1.6–3 mm wide; posterior lobes 2.5–5 mm long, 1.6–3 mm wide. *Labellum* boss white or yellow, orbicular to broadly ovate, 0.6–0.9 mm long, 0.5–0.8 mm wide; margin papillose, red; lateral appendages 0.2–0.9 mm long, red to yellow. *Throat appendages* absent. *Column* 7–11.5 mm long; anthers red–black, subtending hairs translucent; pollen white to yellow; stigma sessile, cushion-like, bilobed (upper lobe developing first). *Capsule* 8.5–16 mm long; untwisted. *Seeds* brown to rust-coloured, ellipsoid, 0.6–1 mm long, 0.3–0.5 mm wide, surface textured but not papillose.

Selected specimens examined. WESTERN AUSTRALIA: Murchison Gorge, 30 Aug. 1984, R. Bates 3894 (PERTH); By Ajana–Kalbarri road at turnoff to Ross Graham Lookout, Kalbarri National Park, 8 Aug. 1993, K. Bremer & M. Gustafsson 31 (PERTH, UPS); 3 miles N of the road from Badgingarra to Jurien Bay, on Cockleshell Gully Rd, 4 Oct. 1974, S. Carlquist 5917 (PERTH, RSA); Kalbarri, 15 Aug. 1966, R. Erickson s.n. (PERTH); 7 km N of Gee Gie Outcamp, 52 km SW of Nerren Nerren Homestead, 14 Sept. 1979, S.D. Hopper 1313 (PERTH); Cooloomia Nature Reserve, 20 km S of Cooloomia on the Old Telegraph Line, 20 Sept. 1979, S.D. Hopper 1438 (PERTH); Coolimba–Eneabba Rd, 2.9 km E of the Coast Rd, 26 Oct. 2002, F. & J. Hort 1882 (PERTH); 42.6 km W along State Barrier Fence Access track W from NW Coastal Highway, Site zu5; 26 Aug. 1994, G.J. Keighery & N. Gibson 1333 (PERTH); Kalbarri airstrip, 5 km S of

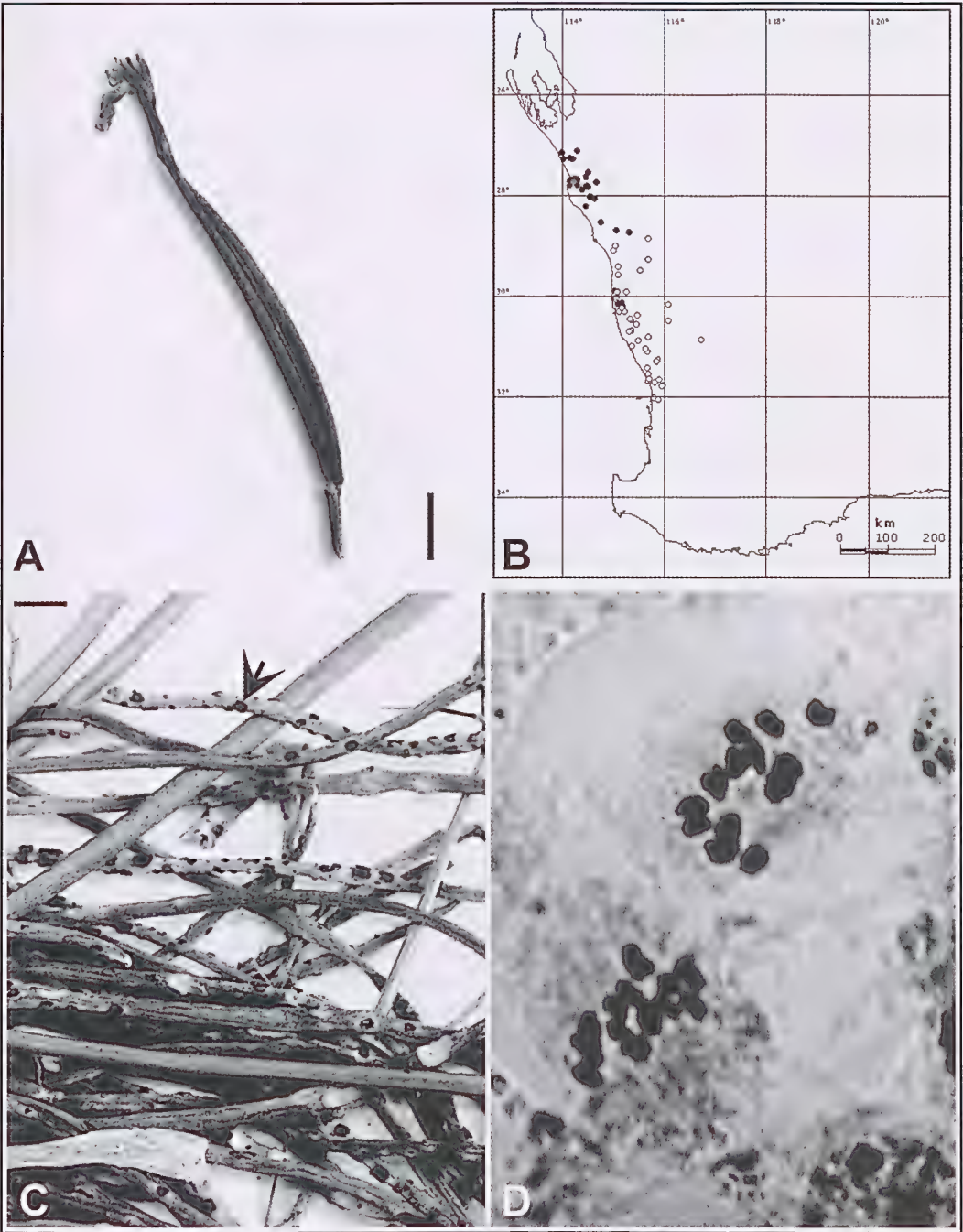


Figure 1. A – Capsule from the holotype of *Stylidium rigidulum* (MEL 2160214); B – Distribution of *Stylidium kalbarriense* (●) and *S. rigidulum* (○); C – Rust sori on the leaves of *Stylidium kalbarriense* (Carlquist 5917, PERTH 03122867); D – Chromosome preparation ($n = 13$) for *Stylidium kalbarriense* (Wege JAW 317). Scale bars at 3mm.

Kalbarri, 1 Oct. 1979, *J. Taylor, M.D. Crisp & R. Jackson* JT 1037 (CANB, PERTH); c. 2 km Salong Meenara Hill Rd from the Ajana–Kalbarri Rd, 14 Aug. 1997, *J.A. Wege & R. Butcher* JAW 317 (PERTH); 1.35 km S from Coorow–Greenhead Rd on track 2.5 km E of Cockleshell Gully Rd, 25 Oct. 2002, *J.A. Wege* JAW 744 (PERTH); 6.5 km E on Mt Adams Rd from Brand Hwy, 8 Oct. 2003, *J.A. Wege* JAW 930 (PERTH).

Distribution. Known from the Murchison region south to Lesueur National Park. (Figure 1B)

Habitat. Grows in sand, often associated with limestone, in heathland or low scrub.

Phenology. Flowering specimens have been collected from August to October.

Conservation status. This species is widespread and not under threat.

Affinities. *Stylidium kalbarriense* can be readily differentiated from *S. rigidulum* by its glandular-hairy inflorescence axis and calyx lobes, and untwisted capsules. These two species also differ slightly in habit: the stems of *S. rigidulum* are always raised well above ground level by stilt roots, whereas the stems of *S. kalbarriense* tend to be buried just under the soil surface (although in some specimens the most recent season's growth increment may be elongated and above ground level).

Notes. The geographic ranges of *S. kalbarriense* and *S. rigidulum* overlap in the Lesueur and Eneabba regions (Figure 1B). They grow in sympatry east of Dongara, and were observed by the author growing side by side without hybridization. Curation of the collection at PERTH uncovered a second potential site of sympatry between these two species: two specimens (*K.F. Kenneally* 4696 and 4697), collected on the same day from the same location. This site, which is NW of Eneabba, has not been successfully relocated in the field.

Rust

Roger Shivas has identified a fungal pathogen, *Puccinia stylidii* McAlpine (Pucciniaceae), on a specimen of *S. kalbarriense* from the Murchison area (PERTH 2527847). Examination of herbarium material housed at PERTH has found that the majority of collections of both *S. kalbarriense* and *S. rigidulum* show some sign of infection by what is presumably the same species of rust (although this has not been confirmed by a rust expert). In both species, the sori are typically restricted to the leaves (Figure 1C), but sometimes occur on the lower scape and, in one specimen of *S. rigidulum* (PERTH 03123030), on the inflorescence and immature capsules.

Puccinia stylidii was first described from a specimen of *S. graminifolium* Sw. ex Willd. from Tasmania (McAlpine 1906). This species of rust has also been documented on the south-west Australian endemics *S. pycnostachyum* Lindl. (Shivas 1989) and *S. merrallii* (F. Muell.) T. Durand & B.D. Jackson (Kenneally & Lowrie 1994). It is not known how many more species of *Stylidium* are hosts for this rust.

Chromosomedata

James (1979) recorded two different chromosome numbers for *S. macrocarpum*: $n = 11$ (Hill River Bridge) and $2n = 26$ (Cockleshell Gully). The Hill River Bridge voucher, collected by James, has been located at PERTH (sheet number 03123170) and is confirmed as *S. rigidulum*. A voucher specimen

collected by James from Cockleshell Gully has not been located; however, a specimen of *S. kalbarriense* collected from this location by G. Stone and G.J. Keighery (who were students at UWA at the time) is housed at PERTH (PERTH 03123189). It is likely that this specimen is the $2n=26$ voucher. A chromosome number of $n=13$ for *S. kalbarriense* is confirmed by the present author (Figure 1D) from a population within Kalbarri National Park (Wege JAW 317; PERTH 05596157).

Studies on several closely related species complexes have established that a change in chromosome number is often a feature of species differentiation in *Stylidium* (e.g. Banyard & James 1979; Coates 1982; Farrell & James 1979; Lowrie *et al.* 1998). *Stylidium rigidulum* and *S. kalbarriense* provide yet another example of this phenomenon.

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Taxonomic notes on the locket trigger plants from *Stylidium* subgenus *Tolypangium* section *Repentes*

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Abstract

Wege, J.A. Taxonomic notes on the locket trigger plants from *Stylidium* subgenus *Tolypangium* section *Repentes*. *Nuytsia* 16(1): 207–220 (2006). Two new trigger plants from south-west Western Australia, *Stylidium perula* Wege and *Stylidium thylax* Wege, are described and illustrated. Revised descriptions are provided for the morphologically allied *S. sacculatum* F.L.Erickson & J.H.Willis and *S. pseudosacculatum* Lowrie, A.H. Burb. & Kenneally. Features of trichome structure are argued to provide important taxonomic characters at the species level in *Stylidium*. The morphology and function of the column cunabulum is explored.

Introduction

Stylidium subgenus *Tolypangium* (Endl.) Mildbr. section *Repentes* Mildbr. comprises a distinct group of creeping trigger plants characterized by adpressed stem leaves bearing a small basal spur, and uni-flowered inflorescences. Prior to this study, six species were known to possess these features: *S. repens* R.Br., *S. sacculatum* F.L.Erickson & J.H.Willis, *S. diplectroglossum* (F.L.Erickson & J.H.Willis) Lowrie, A.H. Burb. & Kenneally, *S. flagellum* Lowrie, A.H. Burb. & Kenneally, *S. pingrupense* Lowrie, A.H. Burb. & Kenneally, and *S. pseudosacculatum* Lowrie, A.H. Burb. & Kenneally. Three of these entities were recently described as part of a broader taxonomic treatment of trigger plants with a creeping habit (Lowrie *et al.* 1999).

In *Stylidium sacculatum* and *S. pseudosacculatum*, the column is dilated just below the apex to form a pouch-like structure that cradles the anthers and/or stigma when the column is poised. Lowrie & Kenneally (1994; 1999) termed the dilated portion of the column a cunabulum (derived from the latin for cradle). The cradling effect is made possible by the presence of a hinge just above the cunabulum. The hinge opens out during the triggering process, enabling pollen to be deposited on, or received from, the insect vector. Erickson (1958) eloquently likened this mechanism to “a miniature locket with elastic hinges, enclosing the precious pack of pollen inside the lid”. This paper serves to revise the taxonomic boundaries within these creeping “locket” trigger plants.

Materials and methods

This study is based on herbarium specimens housed at CANB, K, MEL, PERTH, RSA and on the field observations of the author. Morphological characters were coded using a combination of fresh,

spirit and herbarium material, with the exception of the corolla measurements, which were taken solely from material preserved in 70% ethanol. Trichomes preserved in 70% ethanol were cleared in domestic bleach, mounted in Apathy's Aqueous Mountant and examined under a compound microscope.

Data were recorded as a DELTA dataset (Dallwitz *et al.* 1993), from which species descriptions were generated. Species distribution maps were generated using NatureMap, a departmental mapping application, and are based on PERTH specimen data.

Trichomes

Trichomes are a characteristic feature of the majority of species of *Stylidium* and their structure and distribution often provide excellent characters for the purpose of identifying and delimiting taxa. The four species discussed herein all possess trichomes on the inflorescence; however, differences in trichome length, cellular structure and/or distribution can be used to identify each entity.

Stylidium sacculatum possesses trichomes with multicellular, biseriate stalks and glandular heads (Figure 1A–B). They are conspicuous on the pedicels, hypanthium, abaxial surface of the corolla lobes and usually the labellum margin. In contrast to the species discussed below, the column connective is also glandular. Whilst the trichomes are *c.* 0.1–0.2 mm long on the corolla and upper hypanthium, they are significantly longer (to *c.* 1.8 mm long) at the base of the hypanthium and on the pedicels. These elongated trichomes, which often possess crinkled rather than straight stalks, have been previously been described as pilose (i.e. eglandular; Erickson & Willis 1956; Erickson 1958; Lowrie *et al.* 1999), however, glandular heads are clearly visible using compound microscopy. The heads are *c.* 20–25 μ m long, subglobular, and are comprised of few (3?) cells. Unlike the bright red glandular heads characteristic of the shorter hairs, the heads of the longer hairs tend to lack pigmentation and are therefore extremely difficult to see under low magnification.

Lowrie *et al.* (1999) considered *S. pseudosacculatum* to possess a variable indumentum: “specimens from the type location [near Tammin] have a sparsely glandular hypanthium and those from the Wallaby Hills district have a pilose [eglandular] hypanthium” (p. 146). I consider this to be taxonomically significant. Specimens from the Tammin region are referable to *S. pseudosacculatum*, whilst those bearing eglandular hairs are described below as a new species (*S. perula* Wege, *sp. nov.*).

Stylidium pseudosacculatum possesses glandular trichomes with a comparable structure to those found in *S. sacculatum* (Figure 1C–D). They are conspicuous on the pedicels, hypanthium, labellum and abaxial surface of the corolla lobes. They range in size from 0.15–*c.* 1 mm; those at the base of the pedicels are notably longer than those found on the remainder of the inflorescence. As for *S. sacculatum*, these hairs have in the past been mistakenly described as eglandular (Lowrie *et al.* 1999).

With the exception of collections acquired near the type location of Tammin, all of the specimens cited by Lowrie *et al.* (1999) under *S. pseudosacculatum* possess an eglandular inflorescence indumentum and are referable to *S. perula*. The trichomes are typically restricted to the pedicels and hypanthium, but may be sparingly present on the abaxial surface of the corolla. They vary in size from 0.2–*c.* 1 mm long (the longer hairs tend to be crinkled), and are multicellular and biseriate (Figure 1E). *Stylidium perula* completely lacks glandular trichomes, a condition that is rare within *Stylidium*.

A fourth entity, morphologically similar to *S. pseudosacculatum* (see taxonomic notes below) but with anatomically and morphologically distinct glandular trichomes, is given specific status here

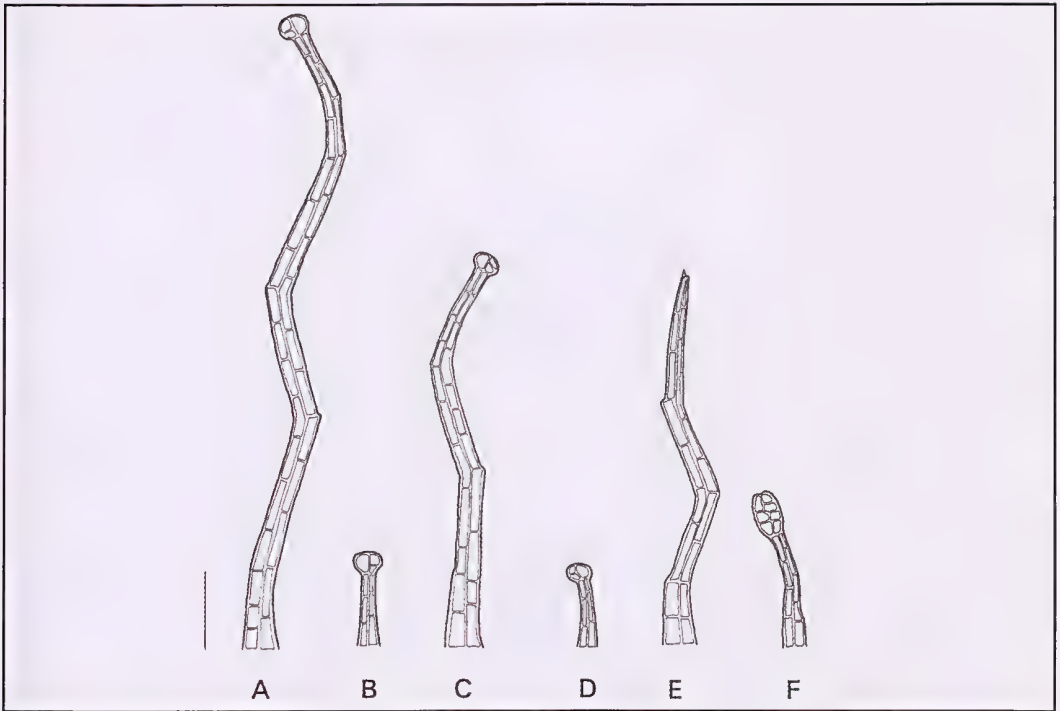


Figure 1. Trichome structure in the locket trigger plants. A, B – *Stylidium sacculatum* (Wege JAW 1087); C, D – *S. pseudosacculatum* (JAW 948); E – *S. perula* (JAW 952); F – *S. thylax* (JAW 984). Scale bar at 0.1 mm.

(*S. thylax* Wege, *sp. nov.*). The trichomes have the same distribution pattern as those in *S. pseudosacculatum*; however, unlike *S. pseudosacculatum* they are fairly consistent in length (0.15–0.3mm), and the heads are larger, ellipsoid and consist of cells arranged in 3 or 4 rows (Figure 1F).

Taxonomy

Key to the creeping locket trigger plants

1. Pedicels short (<2.5 mm), hypanthium nestled amongst apical leaf rosette
 2. Labellum lateral appendages absent. Inflorescence trichomes glandular *S. sacculatum*
 2. Labellum lateral appendages present, filiform. Inflorescence trichomes eglandular (pilose) *S. perula*
1. Pedicels elongated (> 2.5 mm), hypanthium exerted well beyond apical leaf rosette
 3. Inflorescence trichomes eglandular (pilose) *S. perula*
 3. Inflorescence trichomes glandular
 4. Apical leaves ovate to lanceolate. Glandular trichomes *c.* equal in length, 0.15–0.3 mm long, heads ellipsoid *S. thylax*
 4. Apical leaves linear-lanceolate. Glandular trichomes unequal (longest hairs at base of pedicel), 0.15–*c.* 1 mm long, heads subglobular *S. pseudosacculatum*

Stylidium sacculatum F.L.Erickson & J.H.Willis *Muelleria* 1(1): 13 (1956). Base name for *Stylidium repens* R.Br. var. *sacculatum* (F.L. Erickson & J.H. Willis) Carlquist *Aliso* 7: 32 (1969). *Type*: Piawaning (N of Bolgart), Western Australia, 7 Oct. 1952, *R. Erickson s.n.* (*holo*: MEL!; *iso*: K!, PERTH 01642065!, PERTH 05906296!, PERTH 05906288!).

Illustrations. Erickson & Willis (1956) Figures 1–9, p. 14; Erickson (1958) Colour Plate 16, No. 1. Plate 17, Figures 17–25, p. 72; Lowrie *et al.* (1999) Figure 20, p. 147.

Creeping perennial herb 5–15 cm high. *Glandular trichomes* 0.1 mm to c. 1.8 mm long; stalks translucent, multicellular, biseriate, crinkled or straight; heads red or translucent, subglobular. *Eglandular trichomes* absent. *Stems* laterally-spreading, 1–15 shoots arising from each node; internodes glabrous, 1–18 cm long, 0.4–0.7 cm wide. *Stilt roots* papillose. *Leaves* in a terminal rosette with scattered leaves adpressed to stem, linear-lanceolate to lanceolate, 0.15–0.95 cm long, 0.5–1.2 mm wide, glabrous; margin hyaline, serrulate; base spurred; apex mucronate, mucro 0.1–0.5 mm long. *Inflorescence* uni-flowered, without visible bracts or bracteoles. *Pedicels* 0.3–2.2 mm long, glandular. *Hypanthium* nestled amongst apical leaf rosette, obloid, 4.5–8 mm long, 0.9–1.4 mm wide, glandular (hairs at base longer than those in upper portion). *Calyx lobes* free, 2.5–4.8 mm long, 0.5–0.8 mm wide; glabrous or sparingly glandular at base; margin hyaline, serrate; apex acute to mucronate. *Corolla* pale pink to white, throat markings pink, throat yellow; abaxial surface white, yellow in bud, glandular; tube 1.5–3.2 mm long; lobes laterally-paired; anterior lobes obovate, 3.7–6.8 mm long, 2–3.5 mm wide; posterior lobes elliptic to obovate, 3.2–6.5 mm long, 1.6–3.4 mm wide. *Labellum* boss greenish-yellow, narrowly ovate, 0.6–0.9 mm long, 0.3–0.5 mm wide, glandular on margins and abaxial surface; terminal appendage pink-red, 0.3–8 mm long; lateral appendages absent, rarely present (where present 0.05–0.2 mm long). *Throat appendages* 4–6, white, tooth-like to subulate; anterior appendages 0.1–0.7 mm long, 0.1–0.2 mm wide; posterior appendages absent, or present and 0.1 mm long, 0.1 mm wide. *Column* 6–7.5 mm long, dilated at distal end to form a cunabulum; connective glandular; anthers yellow, subtending hairs translucent; pollen yellow; stigma entire, sessile, circular to elliptic, cushion-like. *Capsule* and seed not viewed. (Figure 2)

Selected specimens examined. WESTERN AUSTRALIA: 13.9 km W of Wongan Hills on road to Calingiri, 20 Oct. 1975, *A.H. Burbidge* 2183 (PERTH); Calingiri, 23 Oct. 1998, *A.H. Burbidge s.n.* (PERTH); Bolgart, 40 km N of Toodyay, Oct. 1952, *R. Erickson s.n.* (PERTH); 10.6 miles W of Wongan Hills on road to Calingiri, Oct. 1973, *S.H. James* 73.10/24 (PERTH); On Bindoon–Moora Rd, 0.6 km S of Gillingarra, 20 Oct. 1989, *A. Lowrie s.n.* (MEL, PERTH); Bushland immediately S of the Mogumber–Yarramundah Rd on Great Northern Hwy, 9 Oct. 1995, *J.A. Wege & K.A. Shepherd* JAW 19 (K, MEL, PERTH); Drummond Nature Reserve, W of Bolgart, 11 Nov. 2003, *J.A. Wege* JAW 1087 (AD, CANB, MEL, NSW, PERTH, W); 15 km W of Coomberdale, 2 Nov. 1974, *D.J.E. Whibley* 4924 (AD, PERTH).

Distribution and habitat. Known from several scattered populations in the vicinity of Coomberdale, Gillingarra, Bolgart and Wongan Hills. Grows on clayey-sand or sand in open *Eucalyptus wandoo* or *Corymbia calophylla* woodland. (Figure 2A)

Phenology. Flowering specimens are known from October and November.

Conservation status. Conservation Codes for Western Australian Flora: Priority Three. Although Lowrie *et al.* (1999) describe *S. sacculatum* as “locally abundant and currently not under threat”, it remains a relatively poorly collected trigger plant, with only 14 records from c. 10 localities housed at PERTH. This species is well represented within Drummond Nature Reserve, west of Bolgart; however, it is not clear how many of the remaining localities occur on protected land. Further field observations and collections of this species are required.

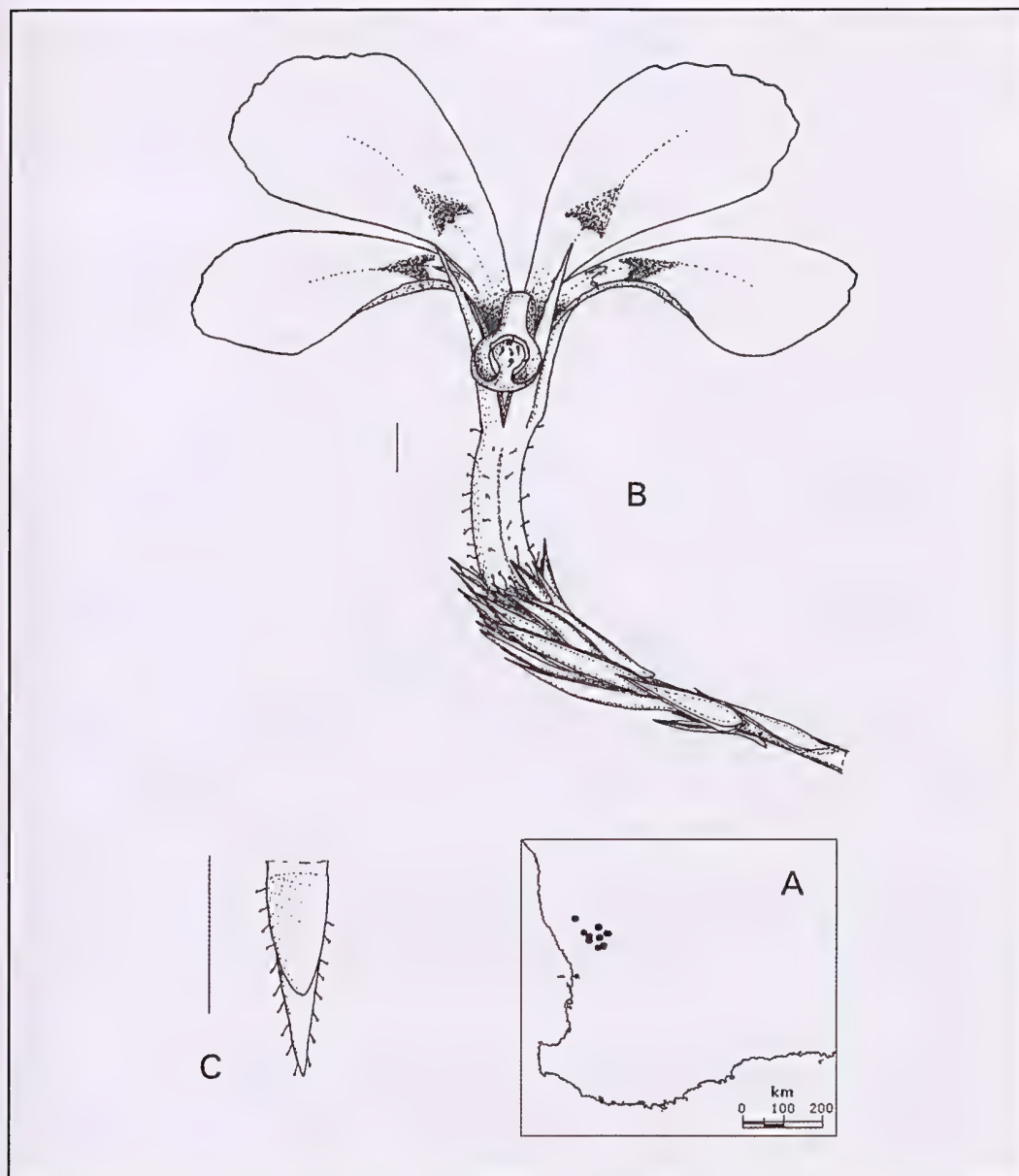


Figure 2. *Stylidium sacculatum*. A – distribution map; B – inflorescence; C – labellum. Scale bar at 1 mm. Drawn from JAW 1087.

Chromosome number. Unknown.

Notes. *Stylidium sacculatum* is distinct within section *Repentes* on account of its extremely short pedicels and its obloid hypanthium that is distinctively nested amongst the apical leaf rosette (Figure 2B). Unlike the species specifically discussed herein, the labellum typically lacks long lateral appendages (Figure 2C); however, rudimentary appendages from 0.05–0.2 mm long were observed in some flowers from some collections (e.g. *Burbidge s.n.* and JAW 1087).

A large bombyliid fly and smaller grey flies were observed pollinating plants at JAW 1087. Ants were also observed running over the laterally-spreading stems of individuals at this site. Erickson (1958: 69) also perceived insect visitors to be conspicuously active on this species. She similarly noted two species of fly (*Comptosia cuneata* Ed. and *C. carculum* Newm.) acting as pollinating agents and ants (*Iridomyrmex* sp.) scurrying over the stems (Erickson & Willis 1956; Erickson 1958). Whilst she observed ants drinking nectar, prompting the column to trigger, it is not known whether they are effective pollinating agents.

Stylidium pseudosacculatum Lowrie, A.H. Burb. & Kenneally *Nuytsia* 13(1): 143 (1999). *Type*: On Great Eastern Hwy, 3.2 km W of Tammin, Western Australia, 16 Oct. 1990, A. Lowrie 112 (*holo*: PERTH 05091284!; *iso*: MEL!).

Illustrations. Lowrie *et al.* (1999) Figure 19, p. 145.

Creeping perennial herb 4–15 cm high. *Glandular trichomes* 0.15–c.1 mm long; stalks translucent, multicellular, biseriate, crinkled or straight; heads red, or transluscent, subglobose. *Eglandular trichomes* absent. *Stems* laterally-spreading, 2–5(9) shoots arising from each node; internodes glabrous, 0.8–24 cm long, 0.5–0.7 cm wide. *Stilt roots* papillose. *Leaves* in a terminal rosette with scattered leaves below, adpressed to stem, linear-lanceolate to lanceolate, 0.2–0.55 cm long, 0.6–1.2 mm wide, glabrous; margin hyaline, serrulate; base spurred; apex mucronate, mucro 0.15–0.3 mm long. *Inflorescence* uni-flowered, without visible bracts and bracteoles. *Pedicels* 3–8 mm long, glandular (longer hairs present at base, shorter hairs above). *Hypanthium* exerted beyond the apical leaf rosette, obloid to ellipsoid, 1.5–4 mm long, 0.7–1.5 mm wide, glandular. *Calyx lobes* free, 2–4 mm long, 0.7–1 mm wide; glabrous or sparingly glandular at base; margin hyaline, serrate; apex acute to mucronate. *Corolla* white, throat markings pink, throat green; abaxial surface flushed pink, glandular; tube 1.2–2 mm long; lobes laterally-paired, elliptic to narrowly obovate; anterior lobes 3.3–5.5 mm long, 1.6–2.8 mm wide; posterior lobes 3.3–5.5 mm long, 1.6–2.5 mm wide. *Labellum* boss greenish-yellow, ovate, 0.5–0.7 mm long, 0.3–0.5 mm wide, glandular on margins and abaxial surface; terminal appendage pink, 0.4–0.6 mm long; lateral appendages yellowish-green often with pink tips, 0.8–1.2 mm long. *Throat appendages* 6, white (occasionally with pink tips), subulate, 0.2–0.7 mm long, 0.1–0.2 mm wide. *Column* 4.7–6.6 mm long, dilated at distal end to form a cunabulum; connective glabrous or papillose; anthers yellow, subtending hairs translucent; pollen yellow; stigma entire, sessile, circular to elliptic, cushion-like. *Capsule* and seed not viewed. (Figure 3)

Other specimens examined. WESTERN AUSTRALIA: c. 2 miles W of Tammin, 5 Oct. 1975, A.H. Burbidge 2132 (PERTH); c. 110 miles E of Perth on Great Eastern Hwy, Oct. 1972, S. James 72.10/2 (PERTH); 2 miles W of Tammin, 9 Nov. 1974, G.J. Keighery 342 (PERTH); Charles Gardner Nature Reserve, S of Tammin, 13 Oct. 2003, J.A. Wege & C. Wilkins JAW 948 (CANB, PERTH).

Distribution and habitat. Known only from the Tammin region. Grows on sand over laterite in *Allocasuarina* heath or shrubland. (Figure 3A)

Phenology. Flowering specimens are known from October and November.

Conservation status. Conservation Codes for Western Australian Flora: Priority Two. *Stylidium pseudosacculatum* is present within Charles Gardner Nature Reserve, south of Tammin; however, the type population west of Tammin is small and under threat (Lowrie *et al.* 1999). This species remains in need of further survey.

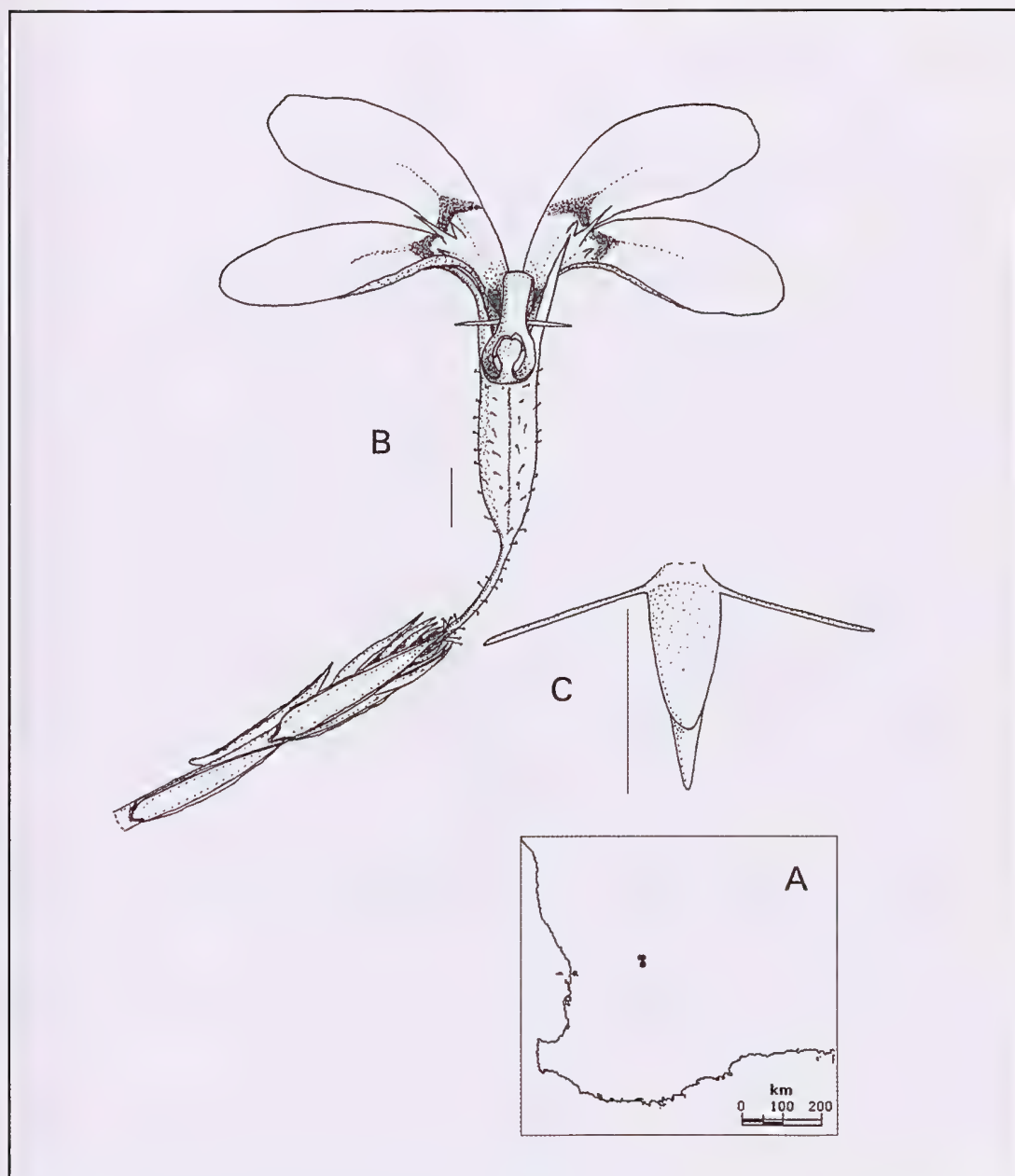


Figure 3. *Stylidium pseudosacculatum*. A – distribution map; B – inflorescence; C – labellum. Scale bar at 1 mm. Drawn from JAW 948.

Chromosome number. Burbidge (1984) recorded a count of $2n=55-60$ (cited as *c.* 30 in Burbidge & James 1991). The voucher specimen (3 km W of Tammin, AHB 1691) has not been located at PERTH or UWA.

Notes. *Stylidium pseudosacculatum* can be readily differentiated from *S. sacculatum* by its shorter hypanthium, longer pedicels and labellum with long lateral appendages (Figure 3B–C). Differences to the two new species described herein are noted below.

***Stylidium thylax* Wege, sp. nov.**

Stylidio repentis affinis sed columna sub apicem sacculata differt.

Typus: 33.9 km E of Forrestiana crossroads on Hyden–Norseman track, 17 Oct. 2003, J.A. Wege & C. Wilkins JAW 984 (*holo*: PERTH 06604773; *iso*: MEL).

Creeping perennial herb 4–8 cm high. *Glandular trichomes* 0.15–0.3 mm long; stalks translucent, multicellular, biseriate, straight; heads red, ellipsoid. *Eglandular trichomes* absent. *Stems* laterally-spreading, 2–5 shoots arising from each node; internodes glabrous, 0.5–7 cm long, 0.4–0.6 cm wide. *Stilt roots* papillose. *Leaves* in a terminal rosette with scattered leaves adpressed to stem, ovate to lanceolate, 0.1–0.4 cm long, 0.6–1.5 mm wide, glabrous; margin hyaline, entire to serrulate; base spurred; apex mucronate, mucro 0.1–0.2 mm long. *Inflorescence* uni-flowered, without visible bracts and bracteoles. *Pedicels* 4–12 mm long, glandular (hairs of c. equal length). *Hypanthium* exerted beyond the apical leaf rosette, ellipsoid (rarely obloid), 1.7–3.5 mm long, 0.8–1.6 mm wide, glandular. *Calyx lobes* free, 1.4–3.2 mm long, 0.6–1 mm wide; glabrous or sparingly glandular at base; margin hyaline, serrate; apex acute to mucronate. *Corolla* white, throat markings pink, throat yellow–green; abaxial surface flushed pink, glabrous or sparingly glandular; tube 1.2–2.5 mm long; lobes laterally-paired, broadly to narrowly obovate; anterior lobes 4–6 mm long, 2.4–4 mm wide; posterior lobes 4–6 mm long, 2–3.5 mm wide. *Labellum* boss yellow, ovate, 0.5–0.8 mm long, 0.3–0.5 mm wide, glabrous or sparingly glandular on abaxial surface; terminal appendage white or pink, 0.3–0.8 mm long; lateral appendages yellowish tinged red or pink, 0.7–1.5 mm long (rarely absent). *Throat appendages* 6–8, yellow–green at base and white above, subulate, 0.1–1.8 mm long, 0.1–0.3 mm wide. *Column* 5.5–7 mm long, dilated at distal end to form a cunabulum; connective glabrous; anthers yellow or red, subtending hairs translucent; pollen yellow; stigma entire, sessile, circular, cushion-like. *Capsule* and seed not viewed. (Figure 4)

Other specimens examined. WESTERN AUSTRALIA: c. 37 km E of Newdegate, 24 Oct. 1975, A.H. Burbidge 2195 (PERTH); 10 km SE of Newdegate–Lake Grace Rd, along Burngup Rd, 30 Oct. 1998, S. Donaldson & G.T. Chandler SD1956 (CANB); South side of Kulin–Holt Rock Rd at the W boundary of Dragon Rocks Nature Reserve, 15 Oct. 2003, J.A. Wege & C. Wilkins JAW 969 (CANB, PERTH).

Distribution and habitat. Known from 3 disjunct populations located east of Newdegate, south of Hyden and east of the Forrestania crossroads. Grows on sand in heath or mallee shrubland. (Figure 4A)

Phenology. Flowering specimens are known from October.

Conservation status. Conservation Codes for Western Australian Flora: Priority Two. This species is known from only three locations, one of which is in a conservation reserve. Further survey effort is required.

Etymology. The species epithet is derived from the Greek (*thylax* – a bag, sack or pouch) in reference to the pouch-like swelling at the column extremity.

Chromosome number. Unknown.

Notes. *Stylidium thylax* is morphologically similar to *S. pseudosacculatum*: both species possess a dilated column, pedicels exerted beyond the apical leaf rosette, a glandular inflorescence indumentum, and long lateral labellum appendages. Unlike *S. pseudosacculatum*, in which the corolla tube is shorter

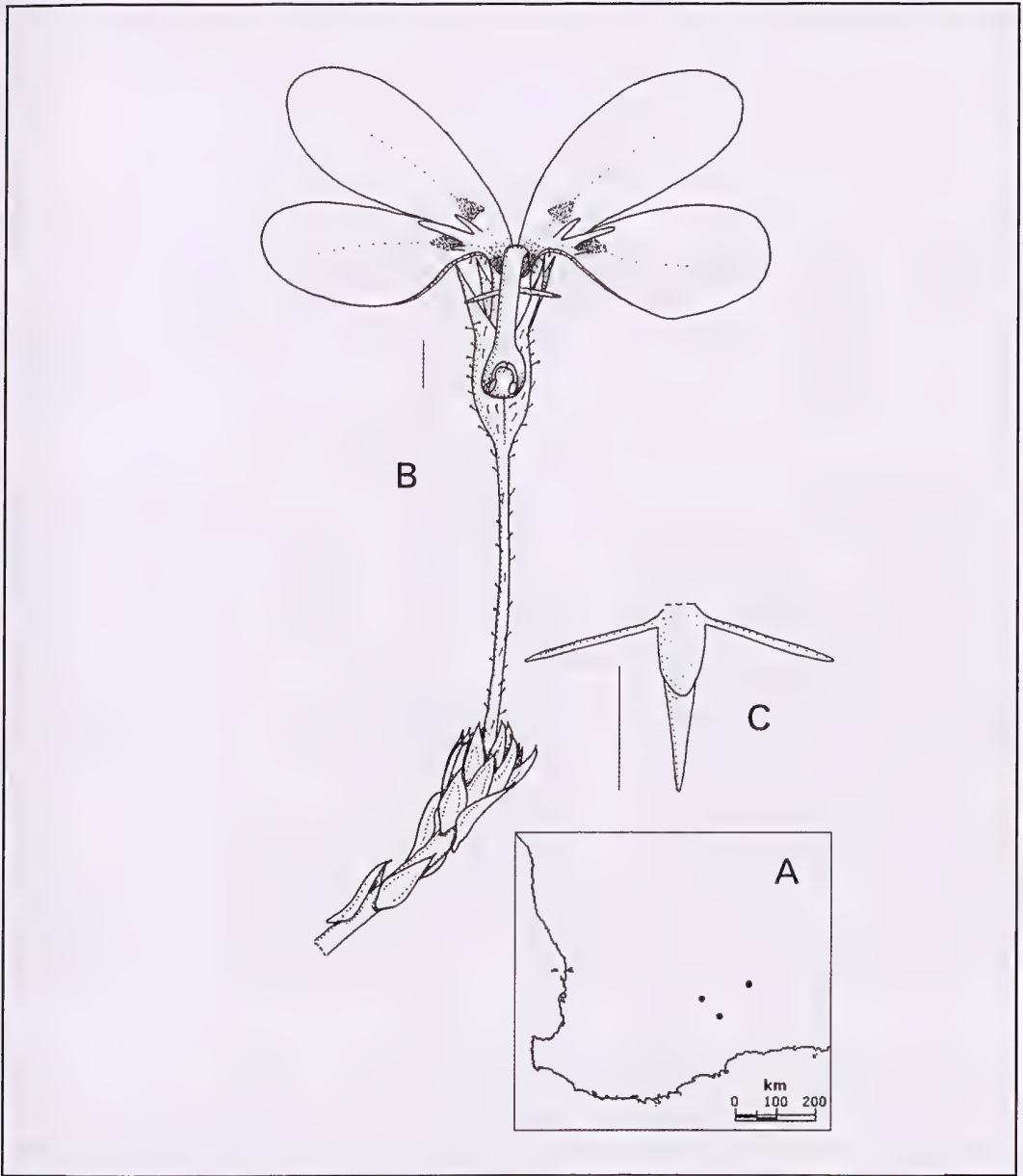


Figure 4. *Stylidium thylax*. A – distribution map; B – inflorescence; C – labellum. Scale bar at 1 mm. Drawn from JAW 984.

than the calyx lobes, *S. thylax* possesses a corolla tube roughly equal in length, or exserted beyond the calyx lobes. *Stylidium thylax* also tends to have broader corolla lobes, shorter apical leaves (ovate to lanceolate rather than linear-lanceolate) and longer throat appendages. Species of *Stylidium* can exhibit subtle variation in features such as corolla shape and size, leaf size and throat appendages number and size. The paucity of specimens available for comparison makes it difficult to ascertain whether the above morphological variation is significant; however, the delineation of *S. thylax* is supported by differences in the length and structure of the glandular trichomes (see trichome section above).

It is of note that the glandular trichomes of *S. thylax* are anatomically similar to those found in *S. repens*. Glandular trichome structure appears to be significant when assessing systematic relationships in *Stylidium*. The true affinities of *S. thylax* may therefore lie with *S. repens*, even though the latter species lacks the pouch-like broadening of the column.

***Stylidium perula* Wege, sp. nov.**

Stylidio pseudosacculato affinis sed indumenta eglandulosa differt.

Typus: W boundary track of Wallaby Hills Nature Reserve, E of York, 13 Oct. 2003, J.A. Wege and C. Wilkins JAW 946 (*holo*: PERTH 06604781; *iso*: CANB, MEL).

Illustrations. Carlquist (1969) Figure 33–34, p. 33, as photographs.

Creeping perennial herb 3–12 cm high. *Glandular trichomes* absent. *Eglandular trichomes* 0.2–c. 1 mm long, multicellular, biseriate, crinkled or straight. *Stems* laterally-spreading, 2–14 shoots arising from each node; internodes glabrous, 0.5–1.1 cm long, 0.4–0.6 cm wide. *Stilt roots* papillose. *Leaves* in a terminal rosette with scattered leaves adpressed to stem, linear-lanceolate to lanceolate, 0.15–0.5 cm long, 0.5–1 mm wide, glabrous; margin hyaline, entire to serrulate; base spurred; apex mucronate, mucro 0.1–0.4 mm long. *Inflorescence* uni-flowered, without visible bracts and bracteoles. *Pedicels* 1–7 mm long, pilose. *Hypanthium* exserted beyond the apical leaf rosette or nestled (in part) amongst it, ellipsoid to obloid, 1.5–5 mm long, 0.7–1.4 mm wide, pilose. *Calyx lobes* free, 2–3.7 mm long, 0.7–1 mm wide, glabrous or sparingly pilose at base; margin hyaline, serrate; apex acute to mucronate. *Corolla* white to pale pink, throat markings dark pink; abaxial surface white or flushed pink, glabrous or sparingly pilose; tube 1.5–2.8 mm long; lobes laterally-paired, obovate to elliptic; anterior lobes 3.2–8 mm long, 1.5–3.8 mm wide; posterior lobes 3–7.8 mm long, 1.4–3.5 mm wide. *Labellum* boss white to yellow, ovate, 0.6–0.8 mm long, 0.3–0.5 mm wide, glabrous; terminal appendage pink, 0.5–0.7 mm long; lateral appendages pink, 0.8–2.5 mm long. *Throat appendages* 6, white, tooth-like, 0.1–0.5 mm long, 0.2–0.4 mm wide. *Column* 4.5–7.5 mm long, dilated at distal end to form a cunabulum; connective papillose; anthers yellow, subtending hairs translucent; pollen yellow; stigma entire, sessile, circular, cushion-like. *Capsule* and seed not viewed. (Figure 5)

Selected specimens examined. WESTERN AUSTRALIA: 12 miles NW of Wickepin on road to Pingelly, 8 Oct. 1974, A.H. Burbidge 1720 (PERTH); c. 18.5 km W of Corrigin, 23 Oct. 1974, A.H. Burbidge 1770 (PERTH); 29.7 km W of Corrigin, 6 Oct. 1976, A.H. Burbidge 2329A (PERTH); Wogerlin Road, 11 km N of junction with Corrigin–Babakin Rd, 18 Sept. 1997, R. Campbell 470 (PERTH); 16 miles S of Narrogin, 26 Oct. 1962, S. Carlquist 922 (NSW, RSA); 39 miles E of Brookton on road to Corrigin, 8 Oct. 1967, S. Carlquist 3693 (CANB, K, MEL, NSW, PERTH, RSA); 14.5 miles W of Wandering on road to Pingelly, 9 Oct. 1967, S. Carlquist 3694 (CANB, K, MEL, NSW, PERTH, RSA); Quairading Shire Reserve, 23 Sept. 1999, G.J. Keighery & N. Gibson 2875 (PERTH); Dryandra State Forest, 23 Oct. 1987, D.M. Rose 420 (CANB, PERTH); Nature Reserve at junction of Jubuk Rd North and Brookton–Corrigin Rd, 14 Oct. 2003, J.A. Wege & C. Wilkins JAW 952 (PERTH).

Distribution and habitat. Known from Wallaby Hills east of York, east to the Corrigin region and south-west to Narrogin. Grows in wandoo woodland, mallee shrubland or heath and favours sandy-clay soils. (Figure 5A)

Phenology. Flowering specimens are known from mid September to late October.

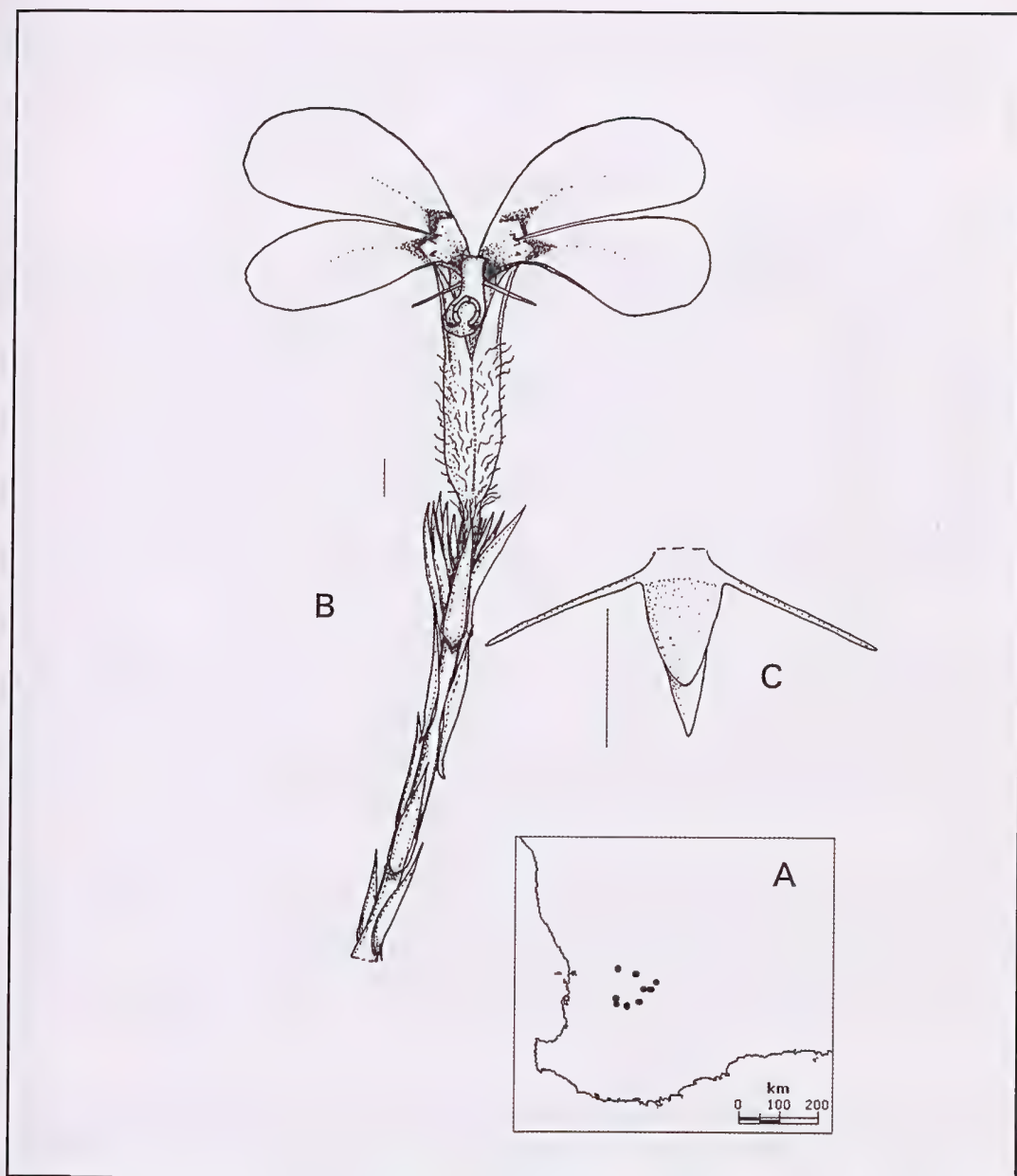


Figure 5. *Stylidium perula*. A – distribution map; B – inflorescence; C – labellum. Scale bar at 1 mm. Drawn from JAW 946.

Conservation status. Represented within several conservation reserves in the wheatbelt region. Not considered threatened.

Etymology. The species epithet is derived from the Greek (*pera* – a little wallet, a pocket) in reference to the pouch-like swelling at the column extremity.

Chromosome number. Unknown.

Notes. Differs from all other members of section *Repentes* in possessing eglandular rather than glandular hairs on the inflorescence (Figure 5). Carlquist collected this taxon west of Wandering (PERTH 03161102) and erroneously considered it to be a hybrid between *S. repens* and *S. sacculatum* (Carlquist 1969).

The Locket

In the creeping trigger plants discussed herein, the column is dilated just below the apex to form a cunabulum in which the anthers and/or stigma rest when the column is poised (Figures 6A–B). A dilated column apex is also present in a small number of morphologically dissimilar trigger plants from south-west Western Australia. *Stylidium preissii* F. Muell. (a tile-leaf trigger plant) possesses a conspicuous cunabulum that cradles the reproductive parts when poised in a manner similar to *S. sacculatum* and allies (Figure 6C). *Stylidium verticillatum* F. Muell. (a whorled-leaf trigger plant) was described by Erickson & Willis (1956) as possessing a column like that of *S. sacculatum*; however, whilst the column is broadened near the apex (Figure 6D), this broadened region is swollen and does not form a cunabulum (Figure 6E). *Stylidium scabridum* Lindl. (a scale-leaf trigger plant) possesses a similarly swollen region near the apex of the column. The column in *S. scandens* R.Br. (another whorled-leaved trigger plant) has also been questionably likened to that in *S. sacculatum* (Erickson & Willis 1956); however, although it broadens slightly above the main hinge a cunabulum is not formed (Figure 6F).

Dilated column apices are more widespread in the annual species from northern Australia (see Carlquist 1979; Lowrie & Kenneally 1994, 1996, 1997; Bean 1999, 2000). For example, *Stylidium dunlopianum* Carlquist possesses an extremely well-developed cunabulum (Figure 6G), the sides of which are laterally extended and shroud the anthers in the set position. A similarly-shaped locket is present in *S. rotundifolium* R.Br. (K.F. Kenneally 8589), *S. perizostera* Lowrie & Kenneally (T. Willing 410A; K.F. Kenneally 11198) and *S. claytonioides* W. Fitzg. (D.J. Edinger 760).

In contrast, *S. rivulosum* Lowrie & Kenneally possesses a column that is only slightly broadened above the main hinge (Figure 6H). Although described as possessing a cunabulum (Lowrie & Kenneally 1997), a distinct cradle for the anthers is not formed. *Stylidium adenophorum* Lowrie & Kenneally (P.G. Wilson 11352), *S. turbinatum* Lowrie & Kenneally (JAW 484) and *S. mucronatum* Lowrie & Kenneally (*n.v.*, see Figure 4 in Lowrie & Kenneally 1997) are similar in this respect. These species possess two marginal bands of eglandular hairs (unicellular papillae) on the adaxial surface of the column (Figure 5H).

The flowers of *Stylidium* are designed to promote cross-pollination: the anthers typically develop first and the stigma develops after the pollen is released. From her detailed observations of *S. sacculatum*, Erickson (1958) suggested that the locket may function as “an economical device for saving loose grains that spill out of the anthers whilst waiting for insect visitors” (p. 70). The inference here is that the “saved” pollen is in turn received by the stigma (i.e. that the locket is an adaptation to facilitate self-pollination). Carlquist (1969) steadfastly came to this conclusion; however, perennial trigger plants from southern Australia have since been shown to possess lethal systems that operate post-zygotically on the products of self-pollination (Banyard & James 1979; Coates & James 1979; James 1979; Willis & Ash 1990; Burbidge & James 1991). The study of Burbidge & James (1991) specifically demonstrated a significantly reduced amount of seed set after self-pollination as compared to cross-pollination in *S. sacculatum*¹. It is therefore unlikely that the locket has evolved as a self-pollination mechanism in the perennial creeping species discussed herein.

¹ No voucher specimen is cited in this paper; material used in this experiment may correspond to *S. pseudosacculatum*. However, this does not change the argument presented here.

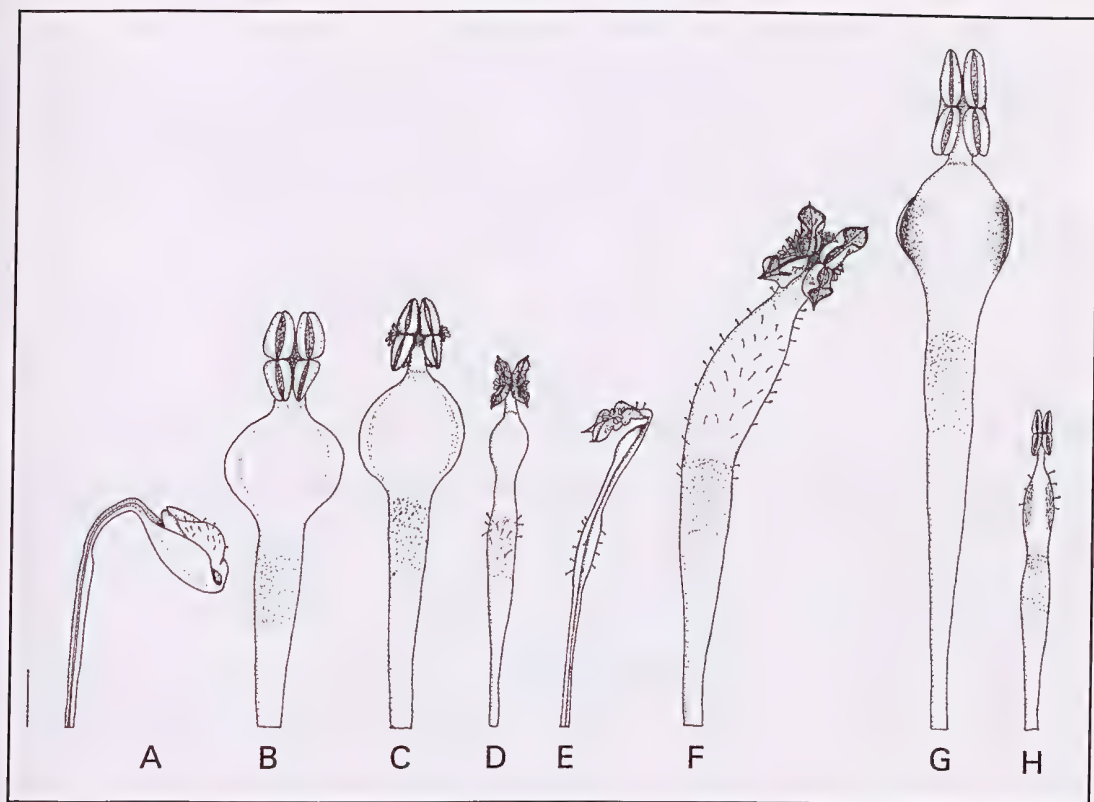


Figure 6. The dilated columns of selected species of *Stylidium*. A, B – *S. sacculatum* (JAW 1087); C – *S. preissii* (JAW 1095); D – *S. verticillatum* (JAW 863); E – *S. scandens* (JAW 814); F – *S. dunlopianum* (D.J. Edinger 566); G – *S. rivulosum* (D.J. Edinger 282). The reproductive organs are cradled by a cunabulum in A–C and G only. Scale bar at 1 mm.

Erickson (1958) suggested that the cunabulum may function to protect the pollen from dessication. Alternatively, it may help safeguard the pollen from thieving insects. Long-tongued flies have been observed by the present author hovering next to recently-triggered flowers (of an unrelated species) in order to cunningly steal pollen from the anther sacs before the column has had a chance to reset. It is not known whether this is a widespread phenomenon.

In contrast to their southern perennial counterparts, it is unlikely that annual trigger plants from tropical Australia possess efficient post-zygotic lethal systems given their reliance on high levels of seed set for regeneration (see Wege 2004). It is therefore possible that the cunabulum in these trigger plants has evolved to facilitate self-pollination. Carlquist (1978; 1979) firmly believed this to be the case. In those tropical species in which the column is only slightly broadened (i.e. *S. rivulosum* and allies), papillae present on the surface of the column may function to capture pollen for later retrieval by the stigma (thus rendering a distinct pouch unnecessary).

As mentioned by Carlquist (1969), the presence of a dilated column in a number of unrelated species of *Stylidium* suggests that this structure has arisen more than once in the evolution of the genus. As yet, there is no robust phylogeny of *Stylidium* to investigate how many times this may have happened. Clearly there is much scope for integrated studies of phylogeny, pollination and breeding systems in this remarkable genus.

Acknowledgements

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Taxonomic observations on the *Stylidium leptocalyx* complex (Stylidiaceae)

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Abstract

Wege, J.A. Taxonomic observations on the *Stylidium leptocalyx* complex (Stylidiaceae). *Nuytsia* 16(1): 221–231 (2006). The name *Stylidium leptocalyx* Sond. has been misapplied for many years. This trigger plant is now recognised to be of restricted distribution in the wandoo country south-west of York, and is characterised by pink flowers with linear calyx lobes, arranged in a loose, corymb-like raceme. *Stylidium stenosepalum* E.Pritz. is reinstated to account for the northern sandplain entity previously known as *S. leptocalyx*. This species differs from *S. leptocalyx* in possessing white flowers with a longer corolla tube and column. Amended descriptions and floral images are provided for both species, along with the morphologically-allied *S. scabridum* Lindl.

Introduction

Stylidium subgenus *Tolypangium* (Endl.) Mildbr. section *Squamosae* (Benth.) Mildbr. comprises those trigger plants with membranous scale-leaves located around or amongst a rosette of linear, grass-like leaves. Twenty-one scale-leaved species are currently recognised, all of which are endemic to the south-west of Western Australia. Whilst similar in habit, these species exhibit considerable variation in inflorescence structure and floral morphology. Furthermore, allied species often show differences in geographic distribution, habitat preference, chromosome number and karyotype (Carlquist 1969; James 1979; Coates 1982; Lowrie *et al.* 1998; Wege 2006). This paper reviews the subgroup of scale-leaved trigger plants that possess a loose corymb-like raceme, informally referred to here as the *Stylidium leptocalyx* Sond. complex.

Taxonomic history

Sonder (1845) named *Stylidium leptocalyx* from a collection James Drummond made as part of his first numbered series. According to Erickson (1969), specimens from this series were obtained the Swan, Avon, Helena and Toodyay Valleys and the Guangan (sandplain). In addition to long linear calyx lobes, this species is characterised by scabrid leaves, a densely glandular scape, flowers arranged in a loose corymb-like raceme and vertically-paired corolla lobes bearing prominent throat appendages. In his type description, Sonder notes that the flowers were rose-coloured in the dried state.

Stylidium scabridum Lindl., named by Lindley (1839) from an earlier Drummond collection from the same collecting region (Erickson 1969), has similar leaves to *S. leptocalyx* and the same inflorescence

structure, but differs in possessing smaller flowers with laterally-paired corolla lobes and less elaborate throat appendages. The similarity in habit between these two species, combined with the inherent difficulty in accurately documenting corolla morphology from herbarium specimens, may account for Bentham's (1869) decision to place *S. leptocalyx* in synonymy under *S. scabridum*.

In 1905, Pritzel described *S. stenosepalum* E.Pritz. to account for an entity from the Irwin District with the above mentioned features of *S. leptocalyx* but with large, white corolla lobes. Upon examining type material of *S. leptocalyx* and *S. stenosepalum*, as well as specimens of *S. scabridum* collected by Drummond, Mildbraed (1908) correctly reinstated *S. leptocalyx*; however, he synonymized *S. stenosepalum* under this taxon. In his ensuing description of *S. leptocalyx*, he notes that the flowers are white with unequal corolla lobes. In accordance with Mildbraed's description, this name has since been applied to specimens occurring from just north of Gingin to north-east of Eneabba (Erickson 1958; Carlquist 1969; James 1979; Coates 1982).

Recent botanical exploration of bushland south-west of York by Fred and Jean Hort uncovered populations of *S. leptocalyx* with pink corolla lobes of approximately equal size. These populations, which are morphologically distinct from those north of Gingin, show close resemblance to the type material of *S. leptocalyx* and appear to be the first collections from this region since Drummond.

In this paper, a revised species description is provided for *S. leptocalyx*. *Stylidium stenosepalum* is reinstated to account for the white-flowered populations north of Gingin, and a modified description supplied. An amended species description is also presented for the morphologically allied *S. scabridum*.

Materials and methods

This study is based on herbarium specimens housed at AD, BM, CANB, CGE, K, MEL, NSW, P, PERTH, RSA and W, and on the field observations of the author. Morphological characters were coded using a combination of fresh, spirit, photographic and herbarium material. Corolla lobe measurements were based solely on material preserved in 70% ethanol from the following collections: *S. leptocalyx* (Wege JAW 683); *S. stenosepalum* (Wege JAW 625, JAW 629, JAW 638, JAW 651, JAW 715, JAW 717, JAW 726, JAW 909, JAW 912, JAW 914); *S. scabridum* (Wege JAW 509, JAW 674).

Data were recorded as a DELTA dataset (Dallwitz *et al.* 1993), from which species descriptions were generated. Species distribution maps were generated using NatureMap, a departmental mapping application, and are based on PERTH specimen data.

Taxonomy

Stylidium leptocalyx Sond. *In*: C. Lehmann, Pl. Preiss. 1: 373, adnote (1845). *Type*: Swan River, J. Drummond 532 (*lecto*, here designated: MEL 2069478!; *isolecto*: BM!, K (2 sheets)!, MEL 2069477!, P!, W (2 sheets)!).

Perennial herb, 7–40 cm high. *Glandular trichomes* 0.2–4 mm long; heads red to red–black, ellipsoid; stalks translucent to yellow. *Multicellular eglandular (pilose) trichomes* 0.5–4 mm long. *Stems* somewhat condensed, internodes c. 0.5–1 cm long. *Stilt roots* glabrous. *Leaves* arranged in a rosette at the stem

apex, linear, 3.5–16 cm long, 1.1–2.2 mm wide, margin involute, apex acute; surface scabrous, papillae 0.15–0.3 mm long. Scale-leaves 0.35–4.8 cm long. *Scape* 4.5–35 cm high, 0.5–1.3 mm wide, glandular throughout, pilose hairs also present on lower portion. Inflorescence a loose corymbose raceme, 6–20-flowered. Bracts and bracteoles linear, glandular; bracts 6–23 mm long, 0.7–1.2 mm wide, scabrous at apex; bracteoles 6–18.5 mm long. Pedicels 8–60 mm long, glandular. *Hypanthium* ellipsoid, 2.5–5 mm long, 1.2–3.4 mm wide, glandular. Calyx lobes free or partly fused (2 fused and 3 free), 6.5–12.5 mm long, 0.6–1.1 mm wide, margin entire, apex subacute, surface and inner apex glandular. *Corolla* pale to bright pink with two set of dark pink throat markings and a creamy-white throat; abaxial surface pale with a darker central pink flush, glandular; tube 3–4 mm long; lobes vertically-paired, posterior lobes fused at base; anterior lobes 8–12.1 mm long, 5–6.7 mm wide, oblong to obovate, falcate and cymbiform, typically overlapping at apex; posterior lobes 8.5–12.5 mm long, 4.5–7.5 mm wide, oblong to obovate, often slightly pandurate. *Labellum* boss white, lenticular, 1–1.3 mm long, 0.5–0.7 mm wide; margin papillose, pink; lateral appendages 0.7–1.2 mm long, pink. *Throat appendages* 6 (1 on each anterior lobe, 2 on each posterior lobe); anterior appendages wing-like, pink, 1.5–2.5 mm long, 0.8–1.2 mm wide; posterior appendages subulate, white, 0.5–1.1 mm long, 0.2–0.3 mm wide. *Column* 8.5–10 mm long, white at base, pink above; connective glandular; anthers blue, subtending hairs absent; pollen white; stigma entire, shortly stalked, elliptic, cushion-like. *Capsule* ellipsoid 4.5–7.5 mm long. *Seeds* pale orange–brown to rust-coloured, obloid, 1.2–1.9 mm long, 0.3–0.4 mm wide. (Figure 1, Figure 2G,H)

Selected specimens. WESTERN AUSTRALIA: Gunapin Ridge Rd, Gunapin State Forest, 17 Nov. 1999, *F. Hort, J. Hort & A. Lowrie* 800 (PERTH); Qualen Road, Gunapin State Forest, 17 Nov. 1999, *F. Hort, J. Hort & A. Lowrie* 801 (PERTH); Little Darkin Swamp, Warrigal Road, Flynn State Forest, 29 Nov. 1999, *F. Hort* 851 (AD, CANB, MEL, NSW, PERTH, RSA); Track off Dale West Rd, West Dale National Park, 16 Oct. 2002, *J.A. Wege & F. Hort* JAW 683 (MEL, PERTH).

Distribution. Occupies a restricted range between Great Southern Highway and Brookton Highway, south-west of York. (Figure 3A)

Habitat. Favours upland habitats and lateritic soils. Grows in association with *Dryandra* in open wandoo woodland, jarrah/marri woodland, or eucalypt shrubland.

Phenology. Flowers have been recorded during October and November.

Conservation status. Conservation Codes for Western Australian Flora: Priority Four. *Stylidium leptocalyx* is known from a handful of populations of varying size found over a range of less than 40 km. It is represented within both Westdale and Wandoo Conservation Parks and is not considered threatened.

Typification. The type material, collected by Drummond in 1839, closely resembles the collections from south-west of York made by the Horts in 1999–2000. This species does not appear to have been collected in the 160 year intervening period; quite remarkable given the relatively close proximity of these populations to Perth. The MEL sheet chosen here as a lectotype has been selected because it bears the annotations of Sonder. (Figure 1)

Chromosome number. Unknown. The counts of $n=8$ recorded under *S. leptocalyx* by both James (1979) and Coates (1982) correspond to *S. stenosepalum* (see notes under that species).



Figure 1. Lectotype of *Stylidium leptocalyx* (MEL 2069478). Scale bar at 1cm. Inset shows label details, with Sonder's annotation on the left.

Notes. In addition to differences in geographic distribution, *Stylidium leptocalyx* can be clearly separated from *S. stenosepalum* on account of its shorter corolla tube, shorter column, and corolla lobes that are pink and bear two sets of dark pink throat markings rather than creamy-white and with one set of throat markings. The relative size of the corolla lobes also typically differs between these species: in *S. leptocalyx* the posterior lobes are roughly equal in size to the anterior lobes, whilst in *S. stenosepalum* they tend to be slightly shorter. Sterile material can be identified with some confidence given the leaves of *S. leptocalyx* are usually broader than in *S. stenosepalum*, and bear slightly longer leaf papillae. Differences to *S. scabridum* are discussed under the notes for that species.

Stylidium stenosepalum E.Pritz. In: Diels, F.L.E. & Pritzel, E. *Fragm. Phyt. Austral.* 590 (1904–05). *Type*: Hab. in distr. Irwin pr. Mingenew in plagis apertis fruticosis flor. m., Sept. 1901, *L. Diels* 4225 (*holo*: B, n.v., destroyed in WWII).

Illustrations. Mildbraed (1908) Figure 21 C, p. 75; Carlquist (1969) Figure 88 (photograph), p. 53; Grieve & Blackall (1982) No. 20, p. 736.

Perennial herb, 12–38 cm high. *Glandular trichomes* 0.2–3.5 mm long; heads red to red–black, ellipsoid; stalks translucent to yellow. Multicellular eglandular (pilose) trichomes 1.5–4 mm long. *Stems* short, or somewhat condensed, internodes 0.4–2 cm long. *Stilt roots* glabrous. *Leaves* arranged in a rosette at the stem apex, linear, 5–25 cm long, 0.7–1.5 mm wide, margin involute, apex acute; surface scabrous (rarely glabrous), papillae to 0.15 mm long. *Scale-leaves* 0.5–7 cm long. *Scape* 7.5–32 cm high, 0.8–2.3 mm wide, glandular throughout, pilose hairs also present on lower portion. *Inflorescence* a loose corymbose raceme, 3–20-flowered. *Bracts* and *bracteoles* linear, glandular, often scabrous at apex; bracts 7–20 mm long, 0.7–2 mm wide; bracteoles 6.5–17 mm long. *Pedicels* 9–53 mm long, glandular. *Hypanthium* globular to ellipsoid, 3.2–7.5 mm long, 2–5.5 mm wide, glandular. *Calyx* lobes partly fused (2 fused and 3 free), 7.4–15 mm long, 0.8–1.7 mm wide, margin entire, apex subacute, surface and inner apex glandular. *Corolla* white (rarely pale pink) with one set of pink–red throat markings; abaxial surface flushed pinkish–red, glandular; tube 5–7.5 mm long; lobes vertically paired, posterior lobes fused at base; anterior lobes 10.5–18 mm long, 5.3–12 mm wide, ovate to oblong or obovate, falcate and cymbiform, sometimes overlapping at apex; posterior lobes 10–17 mm long, 4.3–10 mm wide, ovate to oblong or obovate. *Labellum* boss white, lenticular, 1.2–2 mm long, 0.7–0.9 mm wide; margin papillose, whitish–pink to bright pink; lateral appendages 0.6–1.5 mm long, pink or white with pink tips. *Throat appendages* 6 (1 on each anterior lobe, 2 on each posterior lobe), white to pinkish; anterior appendages wing-like, 2.4–4 mm long, 1.5–2.4 mm wide; posterior appendages subulate, entire or bilobed or trilobed, 1.2–3.2 mm long, 0.5–1.3 mm wide. *Column* 12.5–17 mm long, white, often with a pinkish hinge; connective glandular; anthers greenish to blue, subtending hairs absent; pollen yellow to greenish; stigma entire, shortly stalked, elliptic, cushion-like. *Capsule* subglobular, 5.5–10 mm long. *Seeds* brown to rust-coloured, obloid, 1–1.3 mm long, 0.3 mm wide. (Figure 2A–F)

Selected specimens. WESTERN AUSTRALIA: 11 miles S of Regans Ford, 15 Sept. 1967, *S. Carlquist* 3190 (MEL, NSW, PERTH, RSA); 2 km N of the Watheroo Rd junction along Coalara Rd, 30 Sept. 1987, *D. Coates* 4987 (PERTH); Moore River National Park, c. 15 km S of Moore River and near Brand Hwy, 6 Oct. 1996, *M.G. Corrick & B.A. Fuhrer* MGC 11278 (MEL, PERTH); Badgingarra National Park, just W of New Townsite, 6 Oct. 1981, *E.A. Griffin* 3182 (PERTH); E of Western Titanium Leases, SE of Eneabba, 13 Sept. 1977, *R. Hnatiuk* 770913 (PERTH); 32.4 km W of Arrino, Sept. 1974, *S. James* 74.9/10 (PERTH); 120 miles N of Perth on Gingin–Jurien Bay Rd, Sept. 1972, *G. Keighery & G. Stone* 72.9/9 (PERTH); 8 km E of Dandaragan West towards Dandaragan, 2 Oct. 1971, *S. Paust* 1135 (PERTH); 3.4 km S on Dewar Rd from the Marchagee Track, 21 Oct. 1998, *J.A. Wege* JAW 513 (K, MEL, PERTH); Junction of Bunney Rd and Nebru Rd, NE of Eneabba, 27 Sept. 2002, *J.A. Wege & C. Wilkins* JAW 625 (PERTH); N on Sundalara Rd from Robinson Rd, NE of Eneabba, 27 Sept. 2002, *J.A. Wege & C. Wilkins* JAW 629 (PERTH); c. 2.8 km W from Brand Hwy on Coorow–Green Head Rd, 27 Sept. 2002, *J.A. Wege & C. Wilkins* JAW 638 (PERTH); 4.2 km E of Brand Hwy on Wannamal West Rd, Boonanarring Nature Reserve, 29 Sept. 2002, *J.A. Wege & C. Wilkins* JAW 651 (MEL, NSW, PERTH); W on Barberton Rd from Capitela Rd, SW of Moora, 23 Oct. 2002, *J.A. Wege* JAW 715 (CANB, MEL, PERTH); N of Wandawallah Rd on Rows Rd, SW of Moora, 23 Oct. 2002, *J.A. Wege* JAW 717 (PERTH); 15 km E of Carger Rd on Marchagee Track, Watheroo National Park, 24 Oct. 2002, *J.A. Wege* JAW 726 (PERTH); c. 3 km E on Boonanarring Rd from Brand Hwy, Boonanarring Nature Reserve, 7 Oct. 2003, *J.A. Wege* 909 (AD, CANB, PERTH); 900 m S of Red Gully Rd on Brand Hwy, Moore River National Park, 7 Oct. 2003, *J.A. Wege* 912 (PERTH); c. 3 km S of Gillingarra Rd on Brand Hwy, 7 Oct. 2003, *J.A. Wege* 914 (PERTH).

Distribution. Extends from Boonanarring Nature Reserve north to Badgingarra and the Moora District through to breakaway country north-east of Eneabba. (Figure 3B)

Habitat. Grows in sand or sandy loam within *Banksia* woodland/shrubland, heathland, or open *Eucalyptus* woodland with a shrubby Proteaceous understorey. Often associated with lateritic breakaways.

Phenology. Flowering specimens have been collected from the end of August through to the end of October.

Conservation status. Known from a number of populations in the northern sandplains, several of which are in conservation reserves. No conservation code is applicable.

Typification. Type material of *S. stenosepalum* housed at Berlin was destroyed during World War II (Botanical Museum Berlin-Dahlem 1999), but not before being viewed by Mildbraed (1908). Searches at BM, CANB, K, MEL, NSW, P, PERTH and W have failed to find duplicate material of this Diels collection. A neotype will be chosen if type material is not located during forthcoming searches of other botanical institutions.

Chromosome number. James (1979) refers to two populations of *S. leptocalyx* as having a chromosome number of $n=8$: 120 miles N of Perth on the Gingin–Jurien Bay Rd (PERTH 02859041) and 32.4 km west of Arrino (PERTH 02859033). Both populations are referable to *S. stenosepalum*. Coates (1982) also recorded a count of $n=8$ under *S. leptocalyx*. No voucher specimens have been located at PERTH or UWA; however, the three populations surveyed in his study were also from the northern sandplains (Coates pers. comm.) and are therefore interpreted here as corresponding to *S. stenosepalum*.

Notes. Differences to *S. leptocalyx* and *S. scabridum* are discussed under the notes for those species.

Subtle variation in throat appendage morphology is evident both within and between populations of *S. stenosepalum*. The southern-most populations (i.e. from Boonanarring Nature Reserve to Regans Ford) tend to possess more ornate appendages: the margin of the anterior appendage is irregularly lobed (to varying degrees), and the posterior teeth are bilobed or trilobed. In the remaining populations the margin of the anterior throat appendage varies from slightly irregular to more or less entire, and the posterior teeth are either entire or bilobed. This variation is in accordance with that often shown in species of *Stylidium* both within and between populations and is not considered here to be taxonomically significant.

Stylidium stenosepalum also exhibits considerable variation in corolla morphology both within and between populations, particularly with regards to the shape of the anterior (upper) corolla lobes. In all populations examined, the anterior lobes are falcate and cymbiform, although to varying degrees (Figure 2A–F). In the southern-most populations, the anterior lobes are obovate (rarely oblong) and overlap at the apex to form what Carlquist (1969) termed a “reverse hood” through which the column moves (Figure 2A–B). A comparable hood is present (to varying degrees) in several other scale-leaved species, including *S. leptocalyx*.

In contrast to the southern populations, the anterior lobes in the northern-most populations are typically ovate and less inwardly-curved (Figure 2E–F), and thus the hood tends to be absent (although flowers with hooded anterior lobes were occasionally observed). In the geographically intermediate

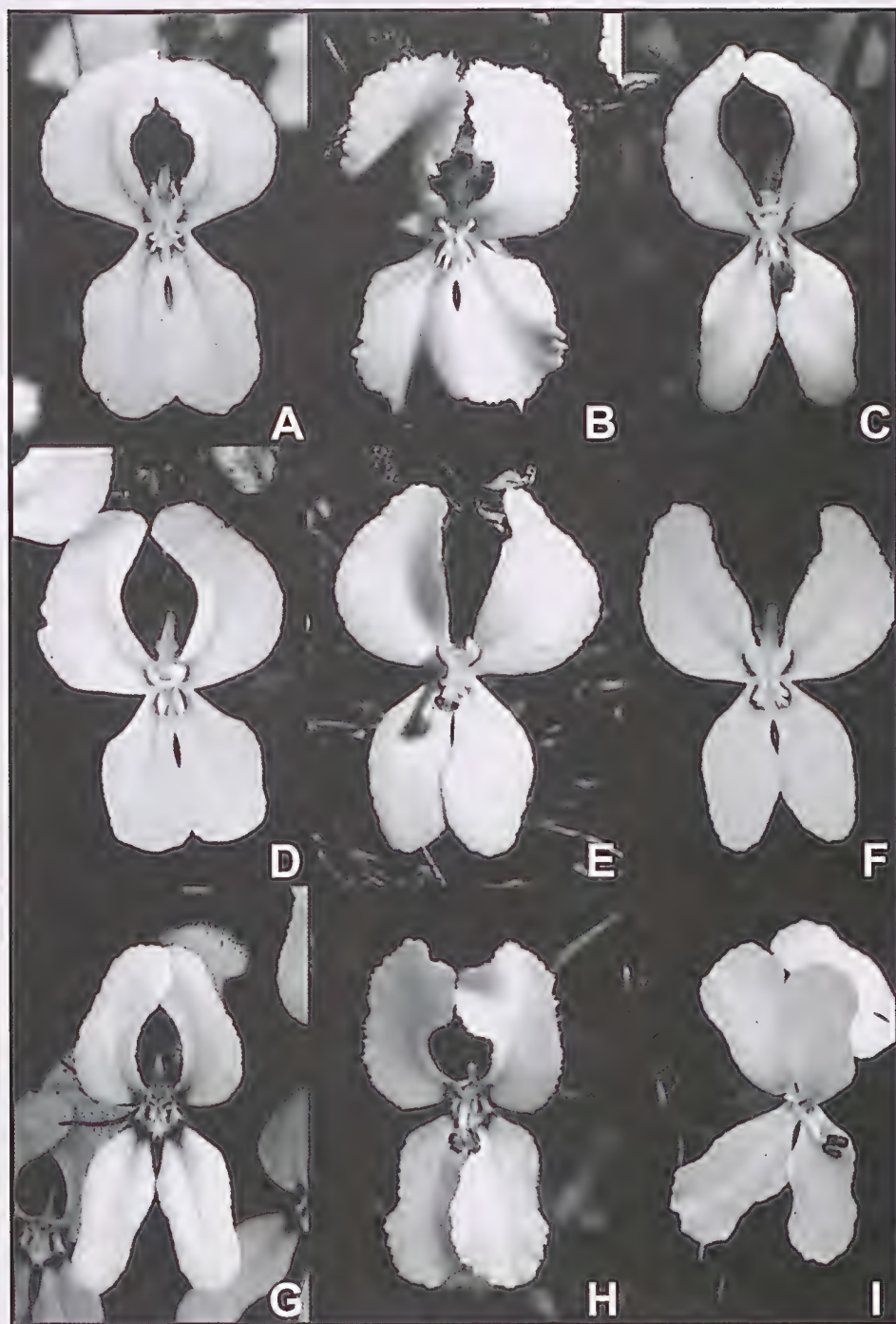


Figure 2. Variation in corolla lobe morphology in the *Stylidium leptocalyx* complex. A–F: *S. stenosepalum*; A – JAW 909, Boonanarring; B – JAW 651 Boonanarring; C – JAW 726, Watheroo National Park; D – JAW 715, SW Moora; E – JAW 625, NE Eneabba; F – JAW 629, NE Eneabba. G–H: *S. leptocalyx*, JAW 683. I – *S. scabridum*, JAW 674. Flowers A–H have vertically-paired flowers in which the column operates from above; flower I has laterally-paired flowers and a column that operates from the side. Flowers not to scale.

populations from south-west of Moora and Watheroo National Park (Figure 2C–D), the anterior lobes are narrowly obovate, ovate or narrowly oblong and the hood tends to be present. These populations appear to be morphological intermediates between the southern and northern populations. The shape of some flowers also seemed to superficially resemble those of *S. leptocalyx* (compare Figure 2C and G).

In all populations, the posterior lobes (which range in shape from obovate to oblong) tend to be slightly shorter than the anterior lobes. This difference in size is more apparent in the northern-most populations. Overall flower size was found to vary considerably within the majority of populations.

An erose corolla lobe margin was evident in some plants of *S. stenosepalum* from Boonanarring Reserve (Figure 2B), although this feature was not consistent within the reserve (Figure 2A). Similarly, *S. leptocalyx* was variable for this feature within the population examined at Westdale National Park (Figure 2G–H), suggesting that this feature is not taxonomically significant.

Corolla lobe shape is often highly diagnostic and as such it continues to be used (in part) to support species boundaries in *Stylidium*, particularly within section *Squamosae* (e.g. Carlquist 1969; Carlquist 1976; Wege 2006); however, whilst some species of *Stylidium* possess corolla lobes that are uniform in shape, others display subtle variation in corolla shape (e.g. *S. graminifolium*, Raulings & Ladiges 2001; *S. crossocepalum*, Wege 2006). The diversity in corolla morphology evident in *S. stenosepalum* is unprecedented within *Stylidium*. Whilst corolla shape in the northern-most populations appears to be distinct from that in the southern-most populations, intraspecific variation combined with the presence of geographically and morphologically intermediate populations suggests that this variation may be continuous in nature.

It is considered practical to broadly circumscribe this species at this point in time. Further field observations targeting geographically intermediate populations in the Shire of Dandaragan, combined with detailed phenetic studies, may help determine whether *S. stenosepalum* should be divided into infraspecific taxa, or is just a variable species.

***Stylidium scabridum* Lindl.** Sketch Veg. Swan Riv. Col. xxviii (1839). Base name for *Candolleascabrida* (Lindl.) F. Muell. Syst. Census Austral. Pl. 85 (1882). *Type*: not cited [Swan River, *J. Drummonds n.*] (*holo*: CGE!; *iso*: G–DC, *n.v.* (microfiche seen), K (2 sheets)!).

Stylidium laxiflorum DC., Prod. 7(2): 782 (1839). *Type*: In Novâ-Hollandiâ ad Swan-river, *J. Drummond n.* (*holo*: G–DC *n.v.*, microfiche seen; *iso*: CGE!, K (2 sheets)!).

Illustrations. Mildbraed (1908) Figure 21D–F, p. 75; Erickson (1958) Plate 46, No. 4. Plate 48, Nos. 11–18, p. 159; Grieve & Blackall (1982) No. 19, p. 736.

Perennial herb, 5–24 cm high. *Glandular trichomes* 0.2–3 mm long; heads red, ellipsoid; stalks translucent. *Multicellular eglandular (pilose) trichomes* 0.5–1.2 mm long. *Stems* short, often branched, internodes 0.2–3 cm long. *Stilt roots* glabrous. *Leaves* arranged in a rosette at the stem apex, linear, 2.5–9.5 cm long, 0.7–2 mm wide, margin involute, apex mucronate; surface scabrous, papillae c. 0.1 mm long. *Scale-leaves* 0.25–3 cm long. *Scape* 4–16.5 cm high, 0.5–1.2 mm wide, glandular throughout, pilose hairs also present on lower portion. *Inflorescence* a loose corymbose raceme, 5–18-flowered. *Bracts* and *bracteoles* linear, glandular, scabrous at apex; bracts 3.5–8.5 mm long, 0.5–1 mm wide; bracteoles 1.5–4 mm long. *Pedicels* 12–40 mm long, glandular. *Hypanthium* globular, 1.5–2.3 mm long, 0.9–2.2 mm wide, glandular. *Calyx lobes* partly fused (2 fused and 3 free), 3.1–5 mm long, 0.5–0.9 mm wide, margin entire,

apex subacute to acute, surface glandular, inner apex glabrous. *Corolla* pale pink to whitish with red–pink throat markings confined to the posterior lobes, throat white; abaxial surface with a central reddish stripe, glandular; tube 2–3 mm long; lobes laterally-paired, oblong to pandurate; anterior lobes 5.5–10.5 mm long, 2.8–5.6 mm wide; posterior lobes 5.5–10.2 mm long, 2.5–4.8 mm wide. *Labellum* boss white, ovate, 0.6–0.8 mm long, 0.4–0.5 mm wide, margin entire; terminal appendage red, 0.2–0.5 mm long; lateral appendages absent. *Throat appendages* 4 or 6 (1 on each anterior lobe, 1 or 2 on each posterior lobe), white; anterior appendages wing-like, 0.5–0.6 mm long, 0.6–1.2 mm wide; posterior teeth 0.2–0.3 mm long, 0.1–0.2 mm wide. *Column* 6.2–8 mm long, dilated at distal end, white; connective glabrous; anthers red to blue–black, subtending hairs absent; pollen white; stigma entire, shortly stalked, elliptic, cushion-like. *Capsule* globular, 3.5–5 mm long. *Seed* not viewed. (Figure 2I)

Selected specimens. WESTERN AUSTRALIA: Site 14, Deefor Rd, 3 km SSW Coolakin Spring, 11 Nov. 1996, M.G. Allen 467 (PERTH); Near Narembene, 72 km S of Merredin, W.E. Blackall s.n. (PERTH); 8 miles from Wyening on secondary road between Wyening and the 68 mile peg S of New Norcia, 3 Oct. 1967, S. Carlquist 3605 (AD, CANB, PERTH, MEL, RSA); W of Wyening, N of Toodyay, 23 Sept. 1951, R. Erickson s.n. (PERTH, MEL); Warrigal Rd, 1.3 km E of Kent Rd, 23 Mar. 2000, F. Hort 974 (PERTH); 2 miles W Tammin on Great Eastern Hwy, Oct. 1968, S. James 68.10/2 (PERTH); New Norcia Monastery, 11 Oct. 1995, D. Papenfus DP 188 (PERTH); 620 m WSW down Deefor Rd from the junction of Kent Rd, 29 Nov. 1994, J.L. Robson s.n. (PERTH); Meckering, 20 Sept. 1914, O.H. Sargent s.n. (PERTH); 750 m N on Kent Rd from Qualen Rd, 21 Oct. 1998, J.A. Wege JAW 509 (K, PERTH, MEL); 800 m S from Deefor Rd on Kent Rd, 16 Oct. 2002, J.A. Wege JAW 674 (CANB, PERTH).

Distribution. Known only from conservation reserves south-west of York and a disjunct population from New Norcia. *Stylidium scabridum* was once more widespread, occurring in pockets of sandplain as far east as Tammin; however, these populations are now extinct (Coates pers. comm.). *Stylidium scabridum* overlaps in geographic range with *S. leptocalyx*; however, there are no records of any sympatric occurrences. (Figure 3C)

Habitat. *Stylidium scabridum* favours sandy habitats in open woodland or heathland.

Phenology. Flowering specimens have been collected from September to late November, with an isolated record for March following abnormally high levels of summer rain.

Conservation status. Conservation Codes for Western Australian Flora: Priority Four. Geographically restricted but represented within conservation reserves in the Shire of York. Not considered threatened.

Chromosome number. James (1979) recorded a count of $n=8$ from 2 miles W of Tammin; this population is now extinct (Coates pers. comm.). Coates (1982) also recorded counts of $n=8$ from two populations; however, no voucher specimens have been located at PERTH or UWA.

Notes. *Stylidium scabridum* is the only scale-leaved trigger plant to have laterally-paired corolla lobes (Figure 2I). This species typically has smaller flowers than *S. stenosepalum* and *S. leptocalyx*, including shorter calyx lobes (with no glandular hairs on the inner surface) and a shorter corolla tube and column. The labellum is less ornate, lacking lateral appendages and a papillose border.

The throat appendages in *S. scabridum* are less conspicuous than those found in either *S. stenosepalum* or *S. leptocalyx* and so it is not surprising that Mildbraed (1908), without the aid of field observations or wet collections, overlooked their presence altogether. Erickson (1958) amended Mildbraed's

description, reporting the presence of six small throat appendages. Examination of wet collections from JAW 674 indicates that throat appendage number can be variable within populations of *S. scabridum*. A broad, low, wing-like appendage is always present on each anterior corolla lobe; however, the posterior corolla lobes may each bear either one or two small, tooth-like appendages. The posterior tooth closest to the anterior corolla lobe was occasionally observed to fuse at the base with the anterior wing.

The degree to which throat appendage morphology varies within species of *Stylidium* remains to be fully explored. Several studies have now demonstrated intraspecific variation in both throat appendage number and morphology (Raulings & Ladiges 2001; Wege 2006). Whilst throat appendages can provide important diagnostic information, these recent observations illustrate that throat appendage characters must be used with caution when delineating species of *Stylidium*.

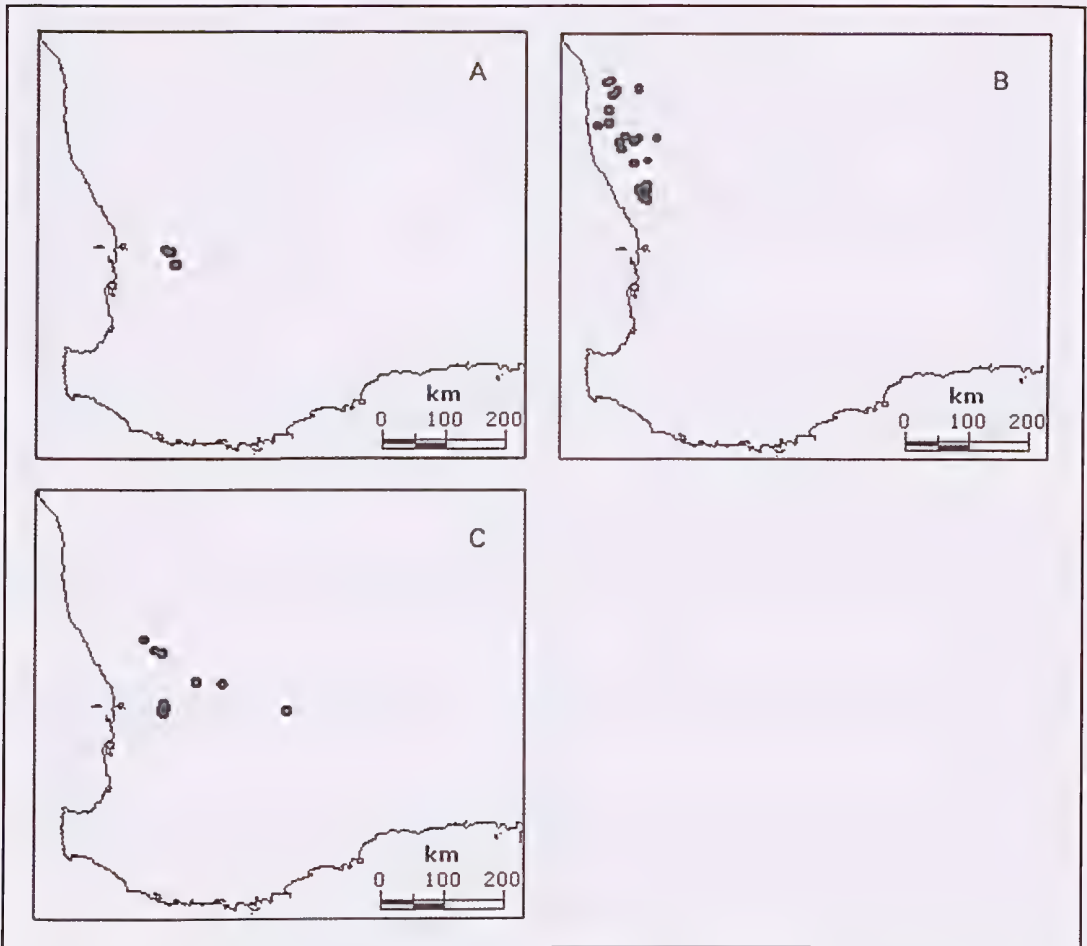


Figure 3. Geographic distribution of members of the *Stylidium leptocalyx* complex (●): A – *S. leptocalyx*; B – *S. stenosepalum*; C – *S. scabridum*.

Acknowledgements

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Taxonomic observations on *Stylidium spathulatum* (Stylidiaceae), with the description of three allied species from section *Saxifragoidea*

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Abstract

Wege, J.A. Taxonomic observations on *Stylidium spathulatum* (Stylidiaceae), with the description of three allied species from section *Saxifragoidea*. *Nuytsia* 16(1): 233–246 (2006). *Stylidium spathulatum* R.Br. (n=14) is lectotypified and a revised species description provided. On the basis of cytological and morphological evidence *Stylidium planirosulum* Wege (n=13) and *S. glandulosissimum* Wege (n=13) are described as new. A third morphologically allied species with conservation priority, *Stylidium gloeophyllum* Wege, is also described. Variation in trichome structure and distribution is shown to be highly diagnostic. Illustrations are provided for the three new species.

Introduction

James (1979) demonstrated that the speciation of *Stylidium* within the south-west of Western Australia is associated with extensive chromosome number change, a phenomenon also hypothesized to occur in trigger plants from northern Australia (Wege 2004). Numbers range from n = 5 to n = 16, with polyploidy on 13, 14 and 15 reported for some species. Studies on morphologically allied species complexes have further established that a change in chromosome number is often a feature of species differentiation (Banyard & James 1979; Farrell & James 1979; Coates 1982; Lowrie *et al.* 1998; Lowrie *et al.* 1999; Wege 2006).

In his landmark study, James (1979) recorded a chromosome number of n = 14 for *S. spathulatum* R.Br. and n = 13 for *S. spathulatum* subsp. *glandulosum* (Mildbr.) Carlquist. Although he suggested the latter taxon required elevation to specific status, this nomenclatural change has never been formally published. As part of the same study, James also detected an anomalous population of *S. spathulatum* from the Shannon region with a count of n=13. Annotations on the voucher specimen indicate that he also believed this entity to be a discrete species. Morphological and anatomical data are provided herein to support the recognition of both entities at the species level. A third related entity with conservation priority is also described and a revised description of *S. spathulatum* provided.

The species described herein belong to *Stylidium* subgenus *Tolypangium* (Endl.) Mildbr. section *Saxifragoidea* Mildbr. All are characterised by a basally-rosetted habit, glandular-hairy leaves and racemose inflorescences bearing flowers with yellow, laterally-paired corolla lobes.

Methods

This research is based on herbarium specimens housed at CANB, K, LD, MEL, NSW, P, PERTH, RSA and W, and on the field observations of the author. Morphological characters were coded using a combination of fresh, spirit and herbarium material. Corolla lobe measurements were based on the following wet samples, stored in 70% ethanol: *S. spathulatum* (Wege JAW 422, 437, 842, 1056, 1058, 1062, 1116, 1161, 1167); *S. planirosulum* (Wege JAW 807, 824, 1171, 1186); *S. gloeophyllum* (Wege JAW 82, 1049, 1151, 1178); *S. glandulosissimum* (Wege JAW 78, 291, 1045, 1069). Trichomes were sampled from a subset of wet collections, cleared in domestic bleach and mounted in Apathy's aqueous mountant before examination under a compound microscope. Data were recorded as a DELTA dataset (Dallwitz *et al.* 1993), from which species descriptions were generated.

Trichomes

Trichomes are a characteristic feature of the majority of species of *Stylidium* and their structure and distribution can be highly diagnostic. The species discussed herein possess glandular trichomes with multicellular, biseriate stalks; however, the length of the stalk and the structure of the glandular head is variable (Figure 1). *Stylidium planirosulum* is characterised by long trichomes on the leaves and lower scape (0.4–1 mm; Figure 1A) and shorter trichomes on the pedicels (0.2–0.4 mm). The glandular heads are comprised of cells in 4 columns and 2 or 3 rows. In contrast, the trichomes are much shorter in *S. gloeophyllum* (0.08–0.3 mm long), and possess flattened, disciform heads comprising several cells arranged in a horizontal plane (Figure 1B). A similar trichome structure is evident in *S. glandulosissimum* (Figure 1C). The trichomes found in *S. spathulatum* are different from the aforementioned species, varying in length from 0.2–0.5 mm long and terminating in a 4-celled glandular head (Figure 1D). All four species possess glandular-hairy leaves; however, the distribution of the hairs on the inflorescence is variable and is outlined in the descriptions below.

Taxonomy

Stylidium spathulatum R.Br., Prodr. 569 (1810). Base name for *Candollea spathulata* (R.Br.) F. Muell. Syst. Census Austral. Pl. 85 (1882). *Type*: Princess Royal Harbour, King Georges Sound, Dec. 1801, R. Brown, Bennett No. 2585 (*lecto*, here designated: BM!; *isolecto*: BM! K 000060697!).

Stylidium bellidifolium Sond. in C. Lehmann, Pl. Preiss. 1: 376 (1845). *Type*: In arenosis ad litus Point Possession, 16 Oct. 1840, Preiss 2259 (*lecto*, here designated: MEL!; *isolecto*: LD!, MEL!, P!, W!).

Stylidium lehmannianum Sond., Delectus Seminum quae in Horto Hamburgensis Botanico: 7–8 (1844). Base name for *Stylidium spathulatum* var. *lehmannianum* (Sond.) Mildbr. in A. Engler, Pflanzenreich IV, 278: 58 (1908). *Type*: not cited [given by Sonder in C. Lehmann, Pl. Preiss. 1: 375 (1845) as “In solo limoso inter frutices ad latus meridionali-occidentale montis Clarence, Plantagenet”, 7 Dec. 1840, Preiss 2261]. (*lecto*, here designated: MEL 2069495!; *isolecto*: LD!, MEL 2069496!, MEL 2069497!, MEL 2069498!, P!, W (4 sheets)!).

Stylidium lehmannianum var. *gracile* Sond. [published as β gracile] in C. Lehmann, Pl. Preiss. 1: 376 (1845). *Type*: in limoso-glareosis sterilibus districtus Hay, 8 Nov. 1840, Preiss 2260 (*lecto*, here designated: MEL 2069494B!). In rupestribus ad Princess Royal Harbour, 11 Oct. 1840, Preiss s.n. (*paralecto*: MEL 2069494A!).

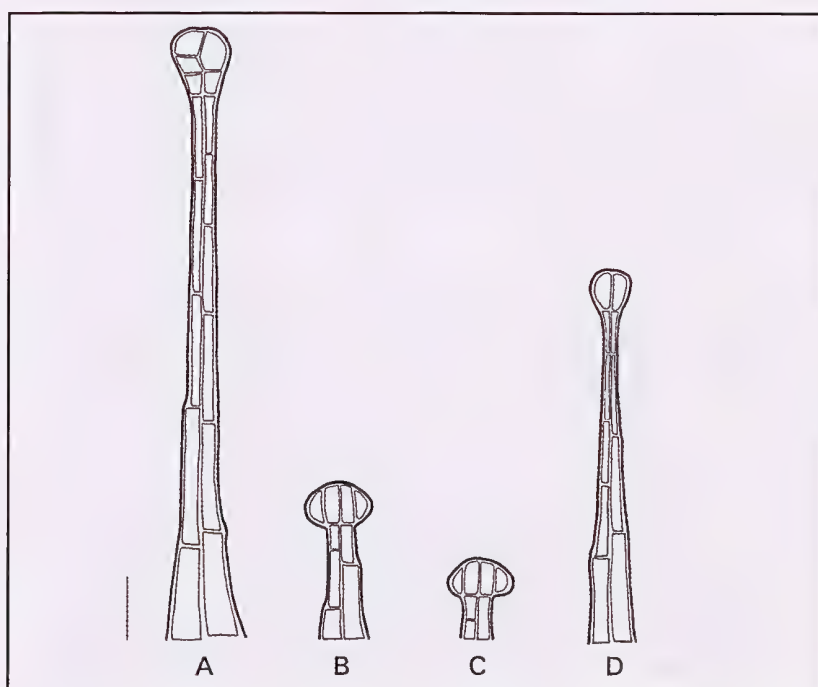


Figure 1. Leaf trichome structure in A – *Stylidium planirosulum* (JAW 807); B – *S. gloeophyllum* (JAW 1049); C – *S. glandulosissimum* (JAW 1069); D – *S. spathulatum* (JAW 842). Scale bar at 50 μ m.

Stylidium spathulatum R.Br. f. *luxuriens* Wawra, *Itinera principum* S. Coburgi 1: 130 (1883). *Type*: Australien, King George's Sound, Wawra Coll. 1909 (*holo*: W!).

Stylidium spathulatum R.Br. var. *obovatum* Ostenf., *Biol. Meddel. Kongel. Danske Vidensk. Selsk.* III, 2: 126 (1921). *Type*: Wilgarup, south of Bridgetown, 1 Oct. 1914, C.H. Ostenfeld 1071 (*holo*: K000060707!).

Illustrations. Botanical Magazine (1872) Tab 5953, 98; Ostenfeld (1921) plate XII, figure 3; Erickson (1958) Plate 32, Nos. 10–17, p. 113; Carlquist (1969) figures 46–47 (as photographs), p. 39; Grieve & Blackall (1982) No. 81, p. 756; Pignatti-Wilkus *et al.* (2000) No. 21, p. 99; Scott (2002) No. 8, p. 181.

Caespitose perennial herb, 5–50 cm high. Stems positioned at or just above the soil surface, condensed or shortly elongated below the leaf rosette, internodes to 4.5 cm long. *Leaves* arranged in a loose, tufted rosette; oblanceolate to spathulate, flat in cross section, 0.8–8 cm long, 1.5–15 mm wide, glandular; apex subacute, terminating in a blunt knob; margin entire. *Glandular trichomes* 0.2–0.5 mm long; stalks translucent to yellow, multicellular, biseriate; heads yellow, turbinate to subglobose, 4-celled. *Eglandular trichomes* absent. *Scapes* 1–c. 20 per plant, 4.5–48 cm high, 0.3–3 mm wide, glandular on lower portion only; sterile bracts absent, occasionally singular or scattered. *Inflorescence* 1–50-flowered, racemose. Bracts ovate, 1.3–3.2 mm long, 0.6–1 mm wide, glabrous. Bracteoles 0.6–2 mm long, glabrous. Pedicels 3.5–30 mm long, glabrous or glandular. *Hypanthium* clavate to elliptic, 2–5 mm long, 0.7–1.6 mm wide, glabrous. Calyx lobes free, 1.5–2 mm long, 0.7–1.2 mm wide, glabrous, margin entire, apex subacute. *Corolla* pale creamy-yellow to yellow with red throat markings; abaxial surface glabrous.

Corolla tube 0.6–0.8 mm long. Corolla lobes laterally-paired, elliptic; anterior lobes 4–7.1 mm long, 2.2–4.3 mm wide; posterior lobes 3.8–6.5 mm long, 1.9–4 mm wide. *Labellum* fully twisted across calyx lobes; boss yellow, narrowly ovate to ovate, 0.4–0.9 mm long, 0.3–0.6 mm wide, margin entire; terminal appendage yellow, 0.2–1.1 mm long; lateral appendages absent. *Throat appendages* yellow, comprising 6 small tooth-like mounds, 0.1–0.3 mm long, interspersed with larger swollen mounds. *Column* 7.5–12 mm long. Anthers red to black; subtending hairs absent; pollen yellow. Stigma entire, sessile, elliptic, cushion-like. *Capsule* clavate to ellipsoidal, 4–7 mm long. Seeds brown, ellipsoidal, 0.3–0.5 mm long, 0.2–0.3 mm wide.

Selected specimens examined. WESTERN AUSTRALIA: Plot 5072, Mitchell River, 23 Oct. 1991, A.R. Annels ARA 1783 (PERTH); 8 miles N of Mount Barker on Albany–Perth highway, 12 Oct. 1967, S. Carlquist 3737 (MEL, NSW, PERTH, RSA); 7 km N of Mowen Rd on Great Northern Rd, 16 Nov. 2001, R.J. Cranfield 17533 (PERTH); Bowelling McAlinden Rd, 3.9 km SW of Trigwell Bridge Rd junction, 22 Nov. 1998, V. Crowley 926 (PERTH); Spencer Rd Reserve, 5 km N of Narrikup, 11 Nov. 1987, E.J. Croxford 5756 (PERTH); Kendenup, 18 Oct. 1951, R. Erickson s.n. (PERTH); c. 4.5 miles S Ellen Brook, Caves Rd, W of Margaret River, Oct. 1966, S. James 66.10/11 (PERTH); Point Possession picnic area, 20 km S of Albany, 20 Oct. 1993, P.C. Jobson 2534 (MEL, PERTH); 500 m W along Redgate Rd from Caves Rd, 29 Oct. 1997, J.A. Wege JAW 437 (PERTH); Just E of Goodga River Bridge on Two Peoples Bay Rd, 29 Oct. 2003, J.A. Wege & C. Wilkins JAW 1056 (PERTH); 800 m E of Watermans Rd on Mount Barker–Porongurups Rd, 30 Oct. 2003, J.A. Wege JAW 1062 (PERTH); c. 2.3 km N of Mornington Rd on Harris River Rd, N of Collie, 13 Nov. 2003, J.A. Wege JAW 1116 (PERTH); 2.13 km S on Shelley Beach Rd from Coombes Rd, West Cape Howe National Park, 4 Dec. 2003, J.A. Wege JAW 1161 (PERTH).

Distribution. Common along the south coast from Two Peoples Bay through to Walpole, extending inland to the Stirling Range, west through Manjimup to Cape Naturaliste, and north to the Collie region.

Habitat. Known from a variety of habitats including woodland, forest and heath, where it favours moist soils associated with granite outcropping, swamps, seepage areas and valley floors.

Phenology. Flowering specimens are known from October to December, with an isolated record for January.

Conservation status. A common and widespread species. No conservation code applies.

Typification. The BM specimen chosen here as the lectotype of *S. spathulatum* bears Brown's field slip. The MEL specimens chosen as lectotypes for *S. bellidifolium*, *S. lehmannianum* and *S. lehmannianum* f. *gracile* all bear the annotations of Sonder.

Chromosome number. James (1979) recorded a count of $n=14$ for specimens in the vicinity of Albany (PERTH 02948303, 02948451), the Porongurups (PERTH 02948141) and Margaret River (PERTH 02948281, 02948311, 06239293). His count of $n=13$ for a population from Shannon is referable to *S. planirosulum* (see notes under that species).

Notes. *Stylidium spathulatum* has a variable habit, displaying both inter- and intrapopulation variation in scape length, width and number per plant, leaf size, and the degree to which the stem is elongated. Diagnostic features include a loose, tufted leaf rosette of oblanceolate to spathulate leaves, glandular trichomes with turbinate heads that are restricted to the stem, leaves, lower scape and sometimes the pedicels, and a yellow corolla with red throat markings and small yellow throat appendages.

***Stylidium planirosulum* Wege, sp. nov.**

Stylidio spathulato affine sed foliorum rosula appressa et trichomatibus longioribus differt.

Typus: Granite outcrop 1.4 km S of Middleton Road on South Western Highway, 11 Nov. 2002, J.A. Wege JAW 807 (*holo*: PERTH 06788475; *iso*: CANB, MEL, K, W).

Caespitose perennial herb, 10–60 cm high. Stems positioned at or just above the soil surface, condensed or rarely very shortly elongated below the leaf rosette. *Leaves* arranged in a somewhat flattened rosette; oblanceolate to spatulate, flat in cross section, 1–5.2 cm long, 1.8–13 mm wide, glandular; apex subacute, terminating in a blunt knob; margin entire. *Glandular trichomes* 0.2–1 mm long; stalks translucent, multicellular, biseriate; heads yellow to yellowish-red, turbinate, comprised of cells in 4 columns and 2 or 3 rows. *Eglandular trichomes* absent. *Scapes* 2–8 per plant, 7–50 cm high, 0.3–1.6 mm wide, glandular on lower portion only; sterile bracts present, scattered. Inflorescence 4–26-flowered, racemose. Bracts subulate, 1.8–2.5 mm long, 0.6–0.7 mm wide, glabrous. Bracteoles 0.7–1.5 mm long, glabrous. Pedicels 4–22 mm long, glandular above bracteoles (rarely below). *Hypanthium* clavate to elliptic, 1.5–4.5 mm long, 0.7–1.4 mm wide, glabrous. Calyx lobes free, 1.5–2.8 mm long, 0.6–0.9 mm wide, glabrous, margin entire, apex subacute. *Corolla* yellow with red throat markings; abaxial surface glabrous. Corolla tube 0.8–1.2 mm long. Corolla lobes laterally-paired, elliptic; anterior lobes 4.2–6 mm long, 2.5–4.2 mm wide; posterior lobes 4.5–5.8 mm long, 2.5–4 mm wide. *Labellum* fully twisted across calyx lobes; boss yellow, ovate, 0.5–0.8 mm long, 0.4–0.6 mm wide, margin entire; terminal appendage yellow, 0.2–0.9 mm long; lateral appendages present (rarely absent), yellow, 0.1 mm long, glabrous. *Throat appendages* yellow, comprising 6–8 small teeth, 0.1–0.3 mm long, interspersed with larger swollen mounds. *Column* 8–10.2 mm long. Anthers red to black; subtending hairs absent; pollen yellow. Stigma entire, sessile, elliptic, cushion-like. *Capsule* ellipsoidal, 3–5 mm long. Seeds brown, ellipsoidal to obloid, 0.35–0.45 mm long, 0.2–0.3 mm wide. (Figure 2)

Selected specimens examined. WESTERN AUSTRALIA: Between Denmark and Nornalup, 10 Nov. 1967, S. Carlquist 4055 (RSA); c. 5 miles W Denmark, Nov. 1971, S. James 71.11/25 (PERTH); Shannon Rock, Oct. 1972, S. James 72.10/71 (PERTH); 26 miles NE Walpole, along Ordinance Rd, 23 Dec. 1971, G.J. Keighery 2743 (PERTH); 1.6 km E of Mount Shadforth, 6 km W of Denmark, 3 Jan. 1994, A.E. Raudino 008 (MEL, NSW, PERTH); Mount Lindesay walk trail, 12 Nov. 2002, J.A. Wege JAW 824 (PERTH); Intersection of Gully and Monastery Rds, Walpole, 4 Dec. 2003, J.A. Wege JAW 1171 (PERTH); Loop Walk at Mount Frankland, N of Walpole, 8 Jan. 2004, J.A. Wege JAW 1186 (AD, CANB, MEL, NSW, PERTH); Near Mount Chudalup, 15 Nov. 1978, E. Wittwer W 2202 (PERTH).

Distribution. Known from karri forest near Denmark, west to D'Entrecasteaux National Park and throughout the Frankland and Shannon regions north to Manjimup.

Habitat. *Stylidium planirosulum* favours the moist run-off areas peripheral to granite outcropping. This species has also been recorded growing on limestone soils in *Agonis* woodland near Walpole.

Phenology. Flowering specimens are known from October through to January.

Conservation status. Represented within several conservation reserves and as such no conservation code applies.

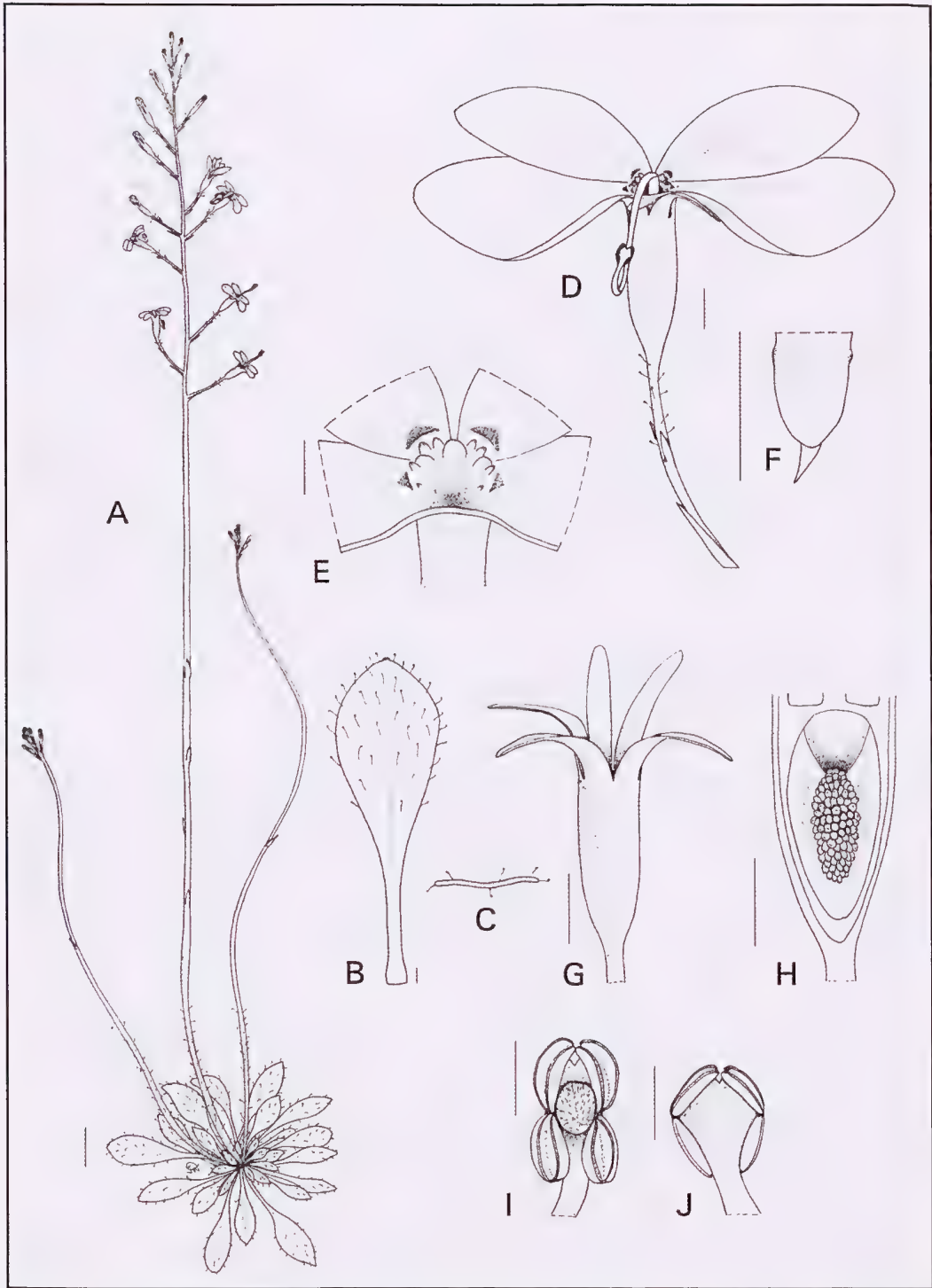


Figure 2. *Styliidium planirosulum* (JAW 807). A – habit; B – leaf; C – T.S. leaf; D – flower; E – throat appendages; F – labellum; G – hypanthium; H – L.S. hypanthium; I – dehiscent anthers and developing stigma; J – connective. Scale bars A: 1cm; B–J: 1mm.

Etymology. From the Latin (*plani* – flat and *rosula* – rosette) in reference to the leaf rosette which tends to be addressed to the soil surface. This name has been chosen in view of the annotation on the aforementioned chromosome voucher of James, which reads: “*Flat rosette form. To be described as a new species?*” Whilst a flattened rosette was clear in all populations examined in the field, it can be difficult to interpret on pressed material.

Chromosome number. James (1979) recorded a count of $n = 13$ under *S. spathulatum* which is applicable to *S. planirosulum* (PERTH 02948567). The type material of *S. planirosulum* was collected in the same vicinity as the chromosome voucher.

Affinities. *Stylidium planirosulum* is readily discernable from *S. spathulatum* using leaf characteristics and consequently sterile material can be identified with some confidence. Unlike *S. spathulatum*, *S. planirosulum* possesses a flattened (rather than tufted) leaf rosette bearing fewer trichomes with longer stalks and larger glandular heads (see Figure 1).

Stylidium planirosulum may also be confused with *S. lineatum* Sond., a species that also possesses a flattened leaf rosette bearing long glandular trichomes. *Stylidium lineatum* tends to have a more robust scape, striated leaves with more rounded apices, and flowers bearing prominent linear throat appendages (see Erickson 1958, p. 113). In contrast to the karri forest habitat of *S. planirosulum*, *S. lineatum* occurs in more northern jarrah and/or marri forests from Perth south to the Nannup region and east to Dryandra forest.

Stylidium glandulosissimum* Wege, *sp. nov.

Stylidio spathulato affine sed trichomatibus brevibus et folis anguste oblanceolatis differt.

Typus: S boundary of Stirling Range National Park on Chester Pass Rd, 31 Oct. 2003, J.A. Wege and C. Wilkins JAW 1069 (*holo:* PERTH 06788459; *iso:* CANB, MEL).

?*Stylidium luteum* var. *glandulosum* Mildbr. in A. Engler, Pflanzenreich IV, 278: 57 (1908). *Stylidium spathulatum* var. *glandulosum* (Mildbr.) F.L. Erickson & J.H. Willis *Victorian Naturalist* 72: 134 (1956). *Stylidium spathulatum* subsp. *glandulosum* (Mildbr.) Carlquist *Aliso* 7: 38 (1969). *Type:* West-Australien: Distr. Stirling: Ohne genauen Standort (*syn:* Maxwell, *n. v.*; F.v. Mueller, *n. v.*).

Illustrations. Grieve & Blackall (1982) No. 81bp. 756.

Stilted perennial herb, 6–30 cm high. Stems elevated above the soil surface, branched or unbranched, internodes to 2.5 cm long. *Leaves* arranged in a tufted rosette, often scattered below; linear to oblanceolate, flat to v-shaped in cross section, 0.6–4.8 cm long, 0.6–4 mm wide, glandular; apex subacute, terminating in a blunt knob; margin entire. *Glandular trichomes* 0.05–0.3 mm long; stalks translucent to yellow, multicellular, biseriate; heads yellow, flattened, comprising cells divided in a horizontal plane. *Eglandular trichomes* absent. *Scapes* 1–5 per plant, 5–29 cm high, 0.5–2 mm wide, densely glandular; sterile bracts absent, occasionally singular or scattered. *Inflorescence* 3–28-flowered, racemose. Bracts linear to subulate, 1.5–9 mm long, 0.6–0.7 mm wide, glandular. Bracteoles 1–2 mm long, glandular. Pedicels 4–14 mm long, glandular. *Hypanthium* elliptic, 1.5–3 mm long, 0.8–1.8 mm wide, glandular. Calyx lobes free, 2.8–4 mm long, 0.6–1 mm wide, glandular, margin entire, apex subacute. *Corolla* yellow, throat markings absent, throat dark yellow; abaxial surface often with red markings, glabrous. Corolla tube 1–

1.7 mm long. Corolla lobes laterally-paired; elliptic; anterior lobes 5–6.5 mm long, 3–4.2 mm wide; posterior lobes 5–6.2 mm long, 3–3.9 mm wide. *Labellum* fully twisted across calyx lobes; boss yellow, ovate to elliptic, 0.6–1.1 mm long, 0.5–0.8 mm wide, margin entire; terminal appendage yellow, 0.3–0.9 mm long; lateral appendages absent or 0.15–0.3 mm long, yellow, glabrous or gland-tipped. *Throat appendages* 8, yellow, truncate or subulate or tooth-like, 0.5–1 mm long, 0.2–0.6 mm wide. *Column* 12.5–14 mm long. Anthers red to red–black; subtending hairs absent; pollen yellow. Stigma entire, sessile, elliptic, cushion-like. *Capsule* and seed not viewed. (Figure 3)

Selected specimens examined. WESTERN AUSTRALIA: 0/Q 205/6 Hume Peak, Stirling Range, 28 Nov. 1994, *S. Barrett* 232 (PERTH); c. 8 miles E of Cranbrook, 12 Oct. 1967, *S. Carlquist* 3752 (CANB, K, MEL, NSW, PERTH, RSA); 68 miles from Albany along the road from Manypeaks to Jerramungup, 14 Oct. 1974, *S. Carlquist* 6028 (PERTH); Stirling Range Drive, 24 km from Chester Pass Rd, lookout SW of Mount Gog, 23 Oct. 1991, *W. Greuter* 23157 (PERTH); Just S of 42 mile peg, Borden Rd S of Stirlings, Nov. 1971, *S. James* 71.11/39 (PERTH); 5 km NW of Chillinup Pool, 29 Oct. 1974, *K.R. Newbey* 4544 (PERTH); 3.3 km S along Boatharbour Rd from Hassell Highway, 28 Oct. 2003, *J.A. Wege* and *C. Wilkins* JAW 1045 (PERTH, W).

Distribution and habitat. Known from the Stirling Ranges south-east to the Wellstead area.

Habitat. Favours mallee shrubland/heath in upland habitats with well-drained sandy-clay soils.

Phenology. Flowering specimens are known from October to December.

Conservation status. Geographically restricted but well represented within Stirling Range National Park. Not considered threatened.

Etymology. The species epithet, *glandulosissimum* (most glandular), is of Latin origin and has been chosen to reflect the densely hairy nature of this taxon.

Typification. There is some confusion as to the identity of the entity described by Mildbraed (1908) as *S. luteum* var. *glandulosum*. Mildbraed cites two type specimens, one collected by Maxwell and the other by Von Mueller, both of which were probably housed at B. The *Stylidium* holdings at B were destroyed during World War II (Botanical Museum Berlin-Dahlem 1999) and duplicate material has not been located. It can be assumed that Mildbraed's taxon has a stilted, basally tufted habit with narrow leaves like that of *S. luteum* R.Br. The type description states that the leaves, scape and sometimes all of the few-flowered inflorescence are shortly glandular-pubescent.

It is more than likely that *S. glandulosissimum* was represented in this type material. The protologue states the type of *S. luteum* var. *glandulosum* was collected from the Stirling district, within the known range of *S. glandulosissimum*. Furthermore, Mildbraed refers to the inflorescence of some specimens as totally glandular hairy. *Stylidium glandulosissimum* is the only known trigger plant from this region with this hair distribution and habit form. Mildbraed does, however, indicate that the distribution of inflorescence hairs in *S. luteum* var. *glandulosum* is variable. Since hair distribution in *S. glandulosissimum* is consistent across its range, it is likely that Mildbraed's type material comprised more than one taxon. This is not an unusual occurrence in the early taxonomic research on *Stylidium*. Botanists in Europe had only a small number of herbarium specimens at their disposal and trigger plants are notoriously difficult to work with in the dried state. On the basis of Mildbraed's description of *S. luteum* var. *glandulosum*, it is plausible that individuals from the *S. squamellosum* DC. complex were represented

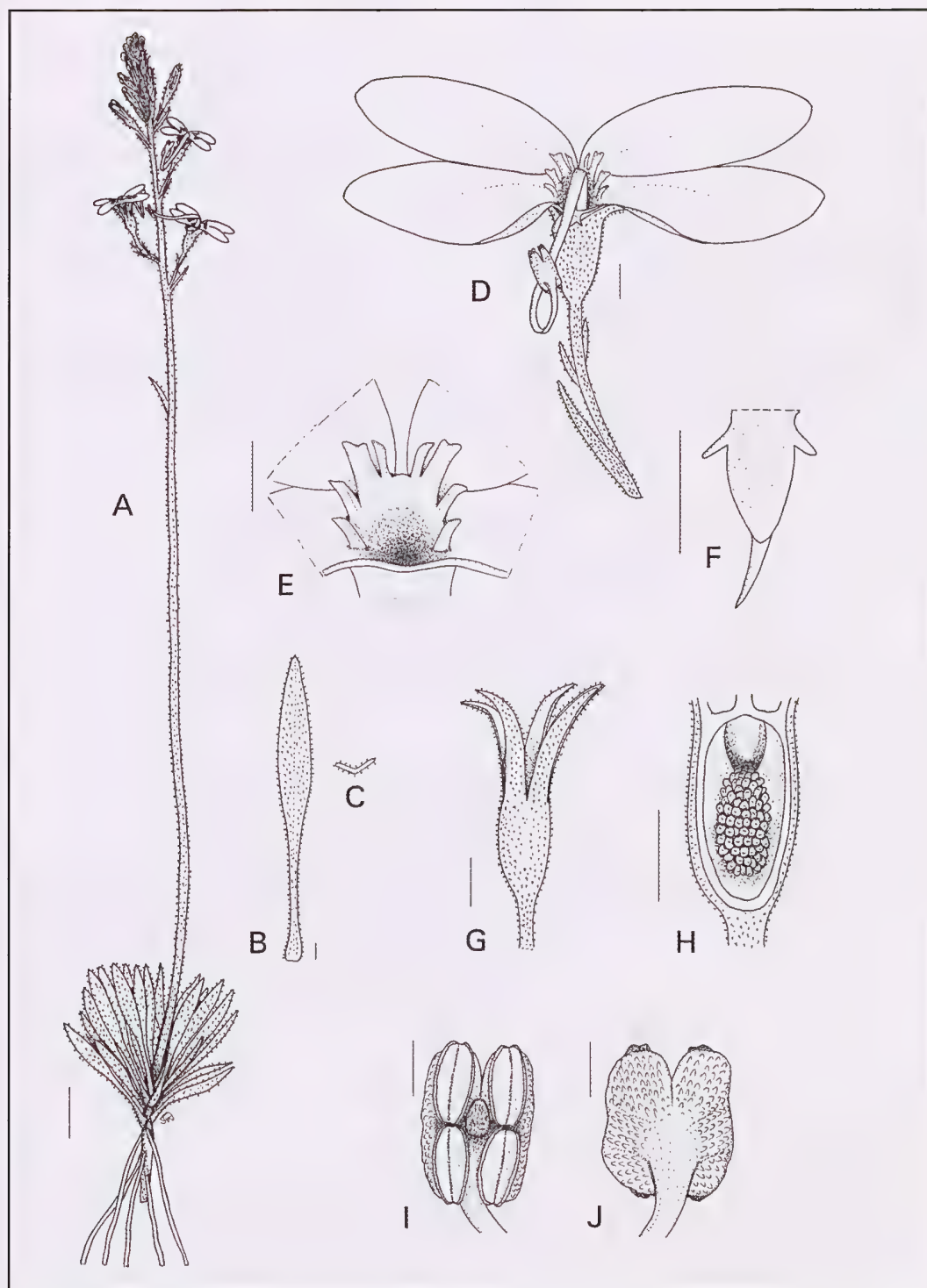


Figure 3. *Stylidium glandulosissimum* (JAW 1069). A – habit; B – leaf; C – T.S. leaf; D – flower; E – throat appendages; F – labellum; G – hypanthium; H – L.S. hypanthium; I – dehiscent anthers and developing stigma; J – cellular connective. Scale bars A: 1cm; B–J: 1mm.

amongst the type material. Members of this complex possess a comparable habit, glandular leaves, glabrous lower scapes and sparingly glandular inflorescences, and are known to occur in the Stirling District.

Erickson & Willis (1956) regarded *S. luteum* var. *glandulosum* as a variety of *S. spathulatum*, arguing that the more open inflorescence, glandular leaves, and glabrous, oblong hypanthium were characteristic of this species and not of *S. luteum*. This reclassification appears to have been based on the examination of five Maxwell specimens housed at MEL, which were perceived as duplicate type material; however, this interpretation is questioned here. The labels for all specimens bear general locality information ("S.W. Austr." or "W. Austr.") and do not refer to the Stirling District. The specimens on three of the sheets (MEL 293435, 293436 and 293439) possess eglandular trichomes on the leaves rather than glandular trichomes as cited in the type description. These specimens are referable to the recently named *S. daphne* Lowrie & Kenneally. The fourth sheet (MEL 293438) comprises flowering material only, but also appears referable to *S. daphne*. *Stylidium daphne* is geographically restricted to the south coast east of Albany, and is not known from the Stirling Ranges. Specimens on the fifth sheet (MEL 293437) are referable to the *S. squamellosum* DC. complex. There is a slight possibility that this last collection is duplicate type material of *S. luteum* var. *glandulosum* (see preceding paragraph).

Upon raising *S. spathulatum* var. *glandulosum* to subspecific level, Carlquist (1969) made no reference to the type material or type description. On the basis of his collections, his concept of this taxon is known to match that described herein for *S. glandulosissimum*.

The epithet *glandulosum* cannot be applied to Mildbraed's taxon at the species level as it is already in use (*Stylidium glandulosum* Salisb.). Rather than proposing a *nom. nov.* based on extinct types of ambiguous content, a new species based on a new type has been published so as to avoid further taxonomic confusion.

Chromosome number. James (1979) recorded a chromosome count of $n = 13$ (PERTH 02948591).

Affinities. *Stylidium glandulosissimum* can be differentiated from *S. spathulatum* by its narrower leaves, lack of throat markings, more conspicuous throat appendages and structurally distinct trichomes (see Figure 1). Furthermore, the inflorescence in *S. glandulosissimum* is typically glandular throughout, unlike that of *S. spathulatum* in which the hairs are restricted to the base of the scape and the pedicels.

Stylidium glandulosissimum most closely resembles *Stylidium gloeophyllum*. Comparative notes are given below.

***Stylidium gloeophyllum* Wege, sp. nov.**

Stylidium glandulosissimum affine sed habitu densiore et columna brevior differt.

Typus: S of Mount Chudalup on Northcliffe–Windy Harbour Rd [precise locality withheld], 5 Dec. 2003, J.A. Wege 1178 (*holo:* PERTH 06788467; *iso:* CANB, K, MEL, W).

Caespitose perennial herb, 13–47 cm high. Stems positioned at or just above the soil surface, condensed. *Leaves* arranged in a loose, tufted rosette; oblanceolate, petioles conspicuous, flat in cross section, 1.5–7 cm long, 2–12 mm wide, glandular; apex subacute, terminating in a blunt knob; margin

entire. *Glandular trichomes* 0.08–0.3 mm long; stalks translucent, multicellular, biseriate; heads yellow, flattened, comprising cells divided in a horizontal plane. *Eglandular trichomes* absent. *Scapes* (1)2–c. 12 per plant, 10–46 cm high, 0.4–1.8 mm wide; glandular on lower portion only; sterile bracts absent or scattered. Inflorescence 5–23-flowered, racemose. Bracts subulate, 1.5–3.2 mm long, 0.5–0.6 mm wide, glabrous, or with glandular trichomes on margins and base. Bracteoles 0.7–1.5 mm long, glabrous. Pedicels 2–15 mm long, glabrous (rarely sparingly glandular). *Hypanthium* clavate to elliptic, 1.5–3 mm long, 0.7–1.2 mm wide, glabrous. Calyx lobes partly fused (2 fused and 3 free), 1.8–3.6 mm long, 0.5–0.8 mm wide, glabrous, margin entire, apex subacute. *Corolla* pale yellow to apricot-pink, throat markings absent, throat dark yellow; abaxial surface with dark apricot-pink markings, glabrous. Corolla tube 0.7–1 mm long. Corolla lobes laterally-paired, elliptic; anterior lobes 4–6.5 mm long, 2.2–3.2 mm wide; posterior lobes 3.8–5.5 mm long, 2–3 mm wide. *Labellum* fully twisted across calyx lobes; boss yellow, ovate to elliptic, 0.4–0.9 mm long, 0.3–0.7 mm wide, margin entire; terminal appendage yellow, 0.3–1 mm long; lateral appendages absent or 0.05–0.2 mm long, yellow, glabrous. *Throat appendages* 6 or 8, yellow (occasionally with pink tips), truncate or subulate or tooth-like, entire or bifurcate or trifurcate, 0.1–1.2 mm long, 0.1–0.5 mm wide. *Column* 7–10 mm long. Anthers red–black to black; subtending hairs absent; pollen yellow. Stigma entire, sessile, circular to elliptic, cushion-like. *Capsule* ellipsoidal, 3–4.5 mm long. Seeds brown, ellipsoidal to obloid, 0.4–0.5 mm long, 0.2–0.3 mm wide. (Figure 4)

Selected specimens examined. WESTERN AUSTRALIA: Waychinicup River [precise locality withheld], 12 Nov. 1996, E.J. Croxford 7623 (PERTH); Mouliup, 25 miles E of Albany, Oct. 1931, A. Elders n. (NSW); Toward Two Peoples Bay, Albany [precise locality withheld], 28 Oct. 1985, N. Hoyle 1451 (CANB, PERTH); S on Cheyne Beach Rd from South Coast Hwy [precise locality withheld], 28 Oct. 2003, J.A. Wege & C. Wilkins JAW 1049 (AD, CANB, MEL, NSW, PERTH, RSA).

Distribution. Known from a few populations in the Waychinicup region and the type location south of Northcliffe (over 200 km to the west).

Habitat. Grows in dense shrubland in moist habitats near swamps or granite outcrops.

Phenology. Flowers have been collected from October to December.

Conservation status. Conservation Codes for Western Australian Flora: Priority Three. This species is known from a handful of populations, some of which are within conservation reserves. Not under immediate threat, but in need of further survey.

Etymology. The species epithet is taken from the Greek (*gloeo* – sticky and *phyllum* – leaf) in reference to the sticky mucilage released from the glandular indumentum.

Chromosome number. Unknown.

Affinities. *Stylidium gloeophyllum* has affinity to *S. glandulosissimum* on the basis of trichome type (Figures 1B–C). *Stylidium gloeophyllum* can be differentiated from *S. glandulosissimum* by its shorter column and denser habit. The leaves of *S. gloeophyllum* tend to be longer and broader and the leaf rosette usually sits at soil level. In contrast, individuals of *S. glandulosissimum* are more slender with the stems raised slightly above the soil and supported by conspicuous adventitious roots. *Stylidium gloeophyllum* prefers winter-wet habitats rather than the upland, well-drained habitats of *S. glandulosissimum*. Different habitat preferences are often a feature of species differentiation in *Stylidium* (Carlquist 1969; Carlquist 1976; Coates 1982).

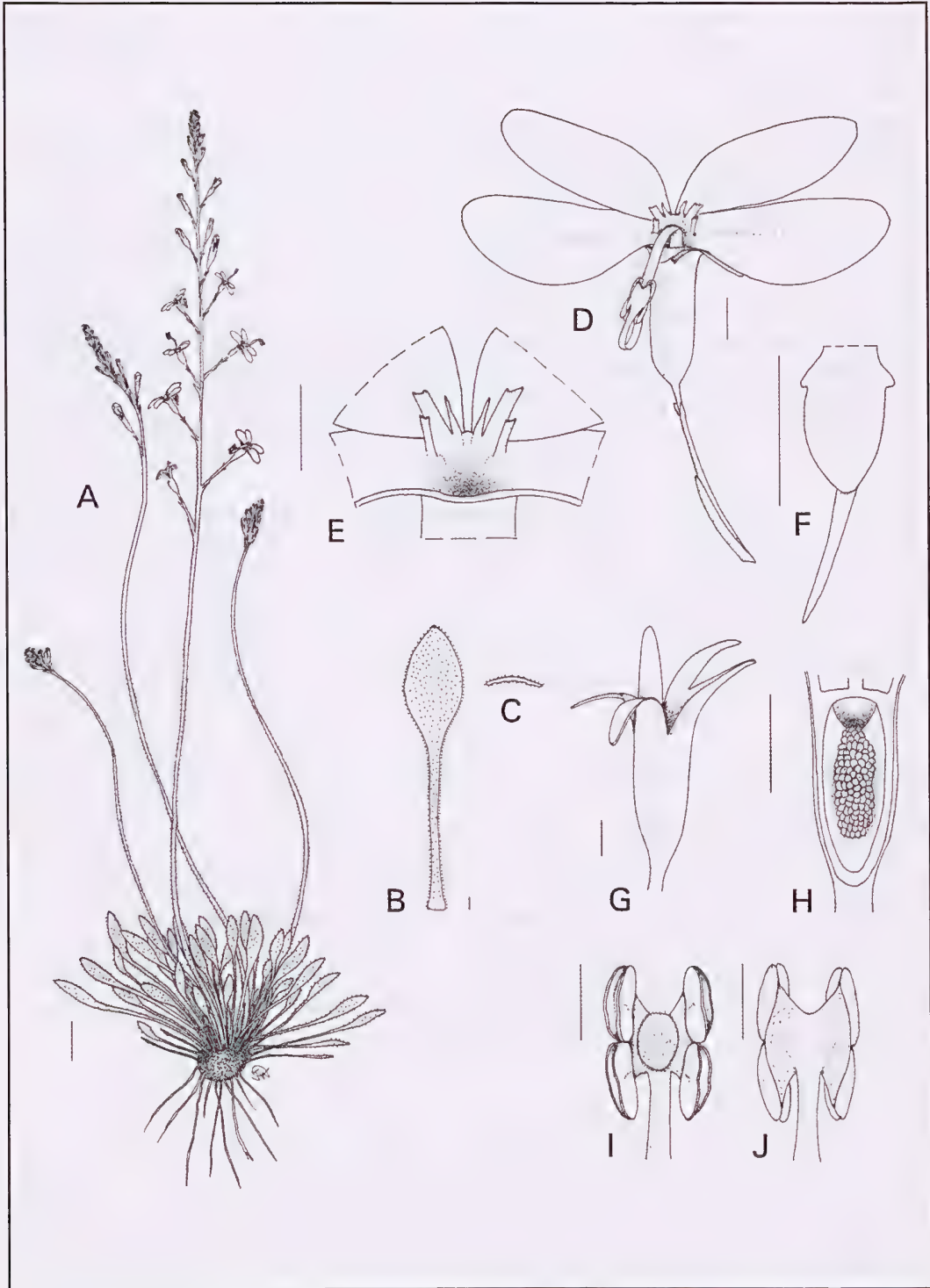


Figure 4. *Stylidium gloeophyllum* (JAW 1178). A – habit; B – leaf; C – T.S. leaf; D – flower; E – throat appendages; F – labellum; G – hypanthium; H – L.S. hypanthium; I – dehiscent anthers and stigma; J – connective. Scale bars A: 1cm; B–J: 1mm.

Additional note. *Stylidium spathulatum* subsp. *acuminatum* Carlquist was erected by Carlquist (1969) on the basis of its acuminate, flabellately-veined leaves, densely glandular-hairy inflorescence and acute calyx lobes. Examination of his type collection, collected from between Collie and Harvey, reveals that this entity possesses an indumentum of both glandular and eglandular trichomes. It can be further differentiated from *S. spathulatum* by its acute throat appendages and lack of throat markings. These differences are sufficient to warrant raising this entity to species level; however, the circumscription of this taxon is unclear.

Only a handful of collections from the Collie region precisely match the robust, basally tufted and exceedingly hairy type specimen. A more widespread entity, with leaf and calyx apices, trichomes and flowers comparable to those of *S. spathulatum* subsp. *acuminatum*, is known from the Whicher Range through to Albany. This entity, referred to by Wheeler *et al.* (2002) by the phrase-name '*Stylidium* sp. Mt Barker (*E.J. Croxford* 1906)', tends to have narrower leaves and a more slender habit, typically with short leafy stems under the leaf rosette. Furthermore, the inflorescence indumentum is usually restricted to the lower portion of the scape (although some variation in trichome distribution is apparent between populations). Features such as trichome distribution and leaf size must be used with caution when delimiting species of *Stylidium*. In this case, additional field observations are deemed necessary to assess whether *Stylidium spathulatum* subsp. *acuminatum* and '*Stylidium* sp. Mt Barker (*E.J. Croxford* 1906)' are indeed two separate entities, or one variable taxon.

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I am ever grateful to the late Sid James, whose cytogenetic work not only provided the initial impetus for my research on *Stylidium*, but continues to be a source of invaluable data. I also thank the Directors and staff at BM, CANB, K, LD, MEL, NSW, P, PERTH, RSA and W for their support and assistance; Carol Wilkins for field help; Paul Wilson for nomenclatural advice and latin assistance; and Terry Macfarlane and an anonymous reviewer for comments on the manuscript. This research was financially supported by an Australian Biological Resources Study grant.

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Stylidium hymenocraspedum* (Stylidiaceae) – a new species for Western Australia, and the lectotypification of *S. maitlandianum

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Abstract

Wege, J.A. *Stylidium hymenocraspedum* (Stylidiaceae) – a new species for Western Australia, and the lectotypification of *S. maitlandianum*. *Nuytsia* 16(1): 247–253 (2006). A new species of trigger plant with conservation priority, *Stylidium hymenocraspedum* Wege, is described and illustrated. The morphologically allied *S. maitlandianum* E.Pritz. is lectotypified and an amended taxonomic description provided.

Introduction

Stylidium maitlandianum E.Pritz., a trigger plant endemic to the northern sandplains of south-west Western Australia, was named by Ernst Pritzel (Diels & Pritzel 1904–05) in honour of the explorer and botanical collector Maitland Brown, who also served as the first resident magistrate at Greenough, Geraldton (Orchard 1999; Shire of Greenough 2002). *Stylidium maitlandianum* is characterised by a basal rosette of spatulate leaves that are adpressed to the soil surface and possess a distinctive irregularly hyaline margin. Flowers are typically purple; however, a yellow-flowered variant occurs south of Badgingarra, just south of the known range of typical *S. maitlandianum*. Whilst corolla colour can vary within species of *Stylidium*, this entity is worthy of specific status on the basis of several additional morphological features. In addition to describing this new species, this paper also serves to lectotypify *S. maitlandianum* and to provide an amended description for this taxon. Both taxa belong to subgenus *Tolypangium* (Endl.) Mildbr. section *Saxifragoidea* Mildbr.

Methods

This study is based on herbarium specimens housed at BM, K, MEL, NSW, P, PERTH and W, and on the field observations of the author. Morphological characters were coded using a combination of fresh, spirit, photographic and herbarium material. Corolla lobe measurements were based solely on material preserved in 70% ethanol from the following collections: *S. maitlandianum* – Wege JAW 211, 646, 728, 917, 919, 932, 934; *S. hymenocraspedum* – Wege JAW 752. Fresh flowering material of *S. hymenocraspedum* provided by Fred Hort was also preserved in ethanol and used for measurement purposes. Data were recorded as a DELTA dataset (Dallwitz *et al.* 1993), from which species descriptions were generated.

Taxonomy

Stylidium maitlandianum E.Pritz. *In* Diels, F.L.E. & Pritzel, E. *Bot. Jahrb. Syst.* 35: 593 (1905). Type citation: "Hab. in distr. Irwin pr. Bukara ad ostium Greenough River in arenosis apertis. *St. striatum* Lindl. e regione illa nunquam adlata est." Specimen label: In fruticetis arenosis inter flumina Moore et Murchison (Bukara), Sept. 1901, *E. Pritzel* 636 (*holo*: B, destroyed WWII; *lecto*, here designated: PERTH 1060260!; *isolecto*: BM!, K 60888!, NSW!, P!, W!).

Illustrations. Mildbraed (1908) p. 63, Figure 20 E–G; Grieve and Blackall (1982) p. 731, No. 6.

Perennial herb, 29–70 cm high. Stems condensed, sitting at or just below the soil surface. *Leaves* arranged in a dense rosette addressed to the soil surface; spatulate, flat in cross section, 1–5 cm long, 2–10 mm wide, glabrous; apex subacute, terminating in a blunt knob; margin hyaline, irregular. *Glandular trichomes* 0.1–0.2 mm long; stalks translucent to yellow; heads black, flattened. Eglandular trichomes absent. *Scapes* 28–70 cm high, 0.8–2.5 mm wide, 1–4 per plant, glabrous except for clusters of glandular hairs near the pedicel axils and occasionally above the uppermost whorl of scape bracts; sterile bracts arranged in 3–5 whorls and often scattered below the inflorescence, 5–13 mm long. Inflorescence 9–c. 50-flowered, racemose (lower pedicels rarely 2-flowered). Floral bracts and bracteoles glabrous or glandular on margins. Bracts subulate, 1.5–5.5 mm long, 0.5–0.7 mm wide. Bracteoles 0.7–2.5 mm long. Pedicels 3.5–9 mm long, glandular. *Hypanthium* clavate to elliptic, 1.5–2.9 mm long, 0.7–1.7 mm wide, slightly longitudinally-ribbed, sparsely glandular throughout or with hairs confined to the upper half. Calyx lobes free, 1.8–3.5 mm long (c. equal in length, or with 2 slightly longer than the remaining 3), 0.5–1 mm wide, glabrous or sparingly glandular on margin, margin entire, apex subacute to acute. *Corolla* purple, throat white to yellowish; abaxial surface glabrous. Corolla tube 1–1.8 mm long. Corolla lobes laterally-paired, elliptic to obovate; anterior lobes 4–5.5 mm long, 2.3–4 mm wide; posterior lobes 3.9–5.3 mm long, 2.2–3.8 mm wide. *Labellum* fully twisted across calyx lobes; boss white to yellowish, ovate to elliptic, 0.5–1.2 mm long, 0.4–0.8 mm wide; margin entire; terminal appendage purple, 0.5–1 mm long; lateral appendages absent. *Throat appendages* 6(8), broadly linear with slightly capitate tips, fused at base and arranged in a semi-circle in 2 groups of 3, white to creamy yellow with a purple subapical band and yellow tips, 0.5–0.8 mm long (2 additional anterior teeth occasionally present, 0.15–0.2 mm long). *Column* 7.5–9.5 mm long. Anthers red–black; subtending hairs absent; pollen yellow. Stigma entire, sessile, elliptic, cushion-like. *Capsule* ellipsoidal, 3–3.5 mm long. Seed not viewed. (Figure 2B)

Selected specimens examined. WESTERN AUSTRALIA: Burma Rd, SE of Walkaway, SE of Geraldton, 10 Sept. 1967, *A.M. Ashby* 2318 (PERTH); 41 miles W of Coorow, 3 Oct. 1974, *S. Carlquist* 5910 (NSW, PERTH, RSA); W side of Natta Rd, 36 km SW of Mingenew, 26 Sept. 1994, *A. Carr* 295 (PERTH); 38 km S of the Geraldton Hwy turnoff on the Eneabba road, 28. Sept. 1976, *R.J. Chinnock* 3198 (AD, PERTH); Hi Vallee property, Warradarge, 23 Oct. 1999, *M. Hislop* 1723 (PERTH); S side of Hill River Bridge on road 9.5 miles E of Jurien Bay S to Cadda Rd, Oct. 1971, *S. James* 71.10/28 (PERTH); Strawberry – Walkaway road, c. 46 km S of Walkaway, 28 Sept. 1976, *R.W. Johnson* 3359 (BRI, PERTH); 8 km due E of Jurien, 3 Oct. 1971, *S. Paust* 1174 (PERTH); c. 3 km from Cockleshell Gully Rd on the track to Mount Lesueur, Lesueur National Park, 28 Sept. 2002, *J.A. Wege & C. Wilkins* JAW 646 (PERTH); c. 3.8 km W of Coalara Rd on Marchagee Track, Watheroo National Park, 24 Oct. 2002, *J.A. Wege* JAW 728 (PERTH); c. 9 km S of Eneabba on Brand Hwy, 9 Oct. 2003, *J.A. Wege* JAW 932 (PERTH); Sandhill between Dandaragan and Badgingarra – midway between Perth and Geraldton, near coast, 6 Oct. 1961, *J.H. Willis s.n.* (MEL).

Distribution and habitat. Known from Watheroo National Park, west towards Jurien Bay, and north to the Geraldton District. Grows on sand in heath, shrubland, or open *Banksia* and/or *Eucalyptus* woodland.

Phenology. Flowering specimens have been collected during September and October.

Conservation status. Represented within several conservation reserves. No conservation code applies.

Typification. No collections were cited with the description of *S. maitlandianum*. Three collections from Diels and Pritzel's expedition are known: *Diels s.n.* (Between Champion Bay and Mount Hill), *Diels* 488 (Victoria District, N of Dongara), and *Pritzel* 636 (In fruticetis arenosis inter flumina Moore et Murchison). These collections were all made in the same general vicinity (ie. between Dongara and Champion Bay) and may represent three separate localities, or may be different expressions of the same locality. The type locality as stated in the protologue – “near Bukara [Bookarra] to (or near to) the mouth of the Greenough River” is similarly ambiguous. It could be interpreted as referring to a single location, or alternatively it may represent a more general description encompassing some or all of the above-mentioned collections.

The unnumbered Diels collection (MEL 233020) bears a National Herbarium of Victoria label with two sets of annotations. In one hand there is an identification as *S. striatum* Lindl., with a corresponding annotation “with scarious edge more prominent than usual; slightly darker flowers”. It is of note that *S. striatum* is also mentioned in Pritzel's protologue. The second annotation, in a different hand, provides the locality and collector information, along with the correct identification. It is not known who wrote these annotations; neither hand appears to match that of Diels. It is possible that this specimen is one of seven types collected by Diels or Pritzel and later donated to MEL (see Short 1990).

Diels 488 (PERTH 1060198) is labelled “*Stylidium Maitlandi* Diels”, indicating that Diels was initially going to describe this species. This sheet bears no details linking it to Pritzel's protologue other than the collection date (September 1901). It is unclear whether Pritzel used this collection in his description of *S. maitlandianum*. Duplicates of *Pritzel* 636, housed at a number of institutions in Australia and Europe, are similarly labelled “*Stylidium Maitlandi* Diels”.

Although there are no collections cited with the description of *S. maitlandianum*, the catalogue of Pritzel's collections identifies *Pritzel* 636 as *S. maitlandianum* E. Pritzel *n. sp.* (p. 638). Since the description and the catalogue entry were published together in April 1905 (Volume 35, part 5), both can be taken as constituting Pritzel's protologue. The collections of Diels are therefore not recognised as types in this study as they were not cited in this protologue.

The Berlin sheet of *Pritzel* 636 (the holotype) was destroyed during World War II (Botanical Museum Berlin-Dahlem 1999); however, a fragment of this specimen was procured by Charles Gardner when he visited Berlin during his term as ABLO in 1937 (Green 1990). This fragment, now housed at PERTH, is chosen here as a suitable lectotype. It is unique amongst the viewed duplicates of *Pritzel* 636. The annotation “*Stylidium Maitlandi* Diels” has been crossed out and replaced with “*S. maitlandianum* E. Pritz. *n. sp.*”, with a further annotation of “Bukara”. It has not been confirmed whether this annotation is in Pritzel's hand since a sample of his handwriting was not available for comparison.

Chromosome number. James (1979) recorded a chromosome number of $n = 12$ (PERTH 01060732 and PERTH 01060759).

Notes. *Stylidium maitlandianum* can be readily differentiated from all other trigger plants on account of the following combination of features: spatulate leaves with an irregular hyaline margin, scapes with 2–5 whorls of bracts, and purple, laterally-paired flowers bearing throat appendages. Differences to *S. hymenocraspedum* are discussed in the notes below.

***Stylidium hymenocraspedum* Wege, sp. nov.**

Stylidium maitlandiano affine sed corolla flava et columna longiore differt.

Typus: Waddi Road, Badgingarra [precise location withheld for conservation purposes], 9 Oct. 2002, *F. & J. Hort* 1854 (*holo*: PERTH06196683!; *iso*: CANB!, MEL!).

Perennial herb, 27–75 cm high. Stems condensed, sitting at or just below the soil surface. *Leaves* arranged in a dense rosette adpressed to the soil surface; spatulate, flat in cross section, 1.5–7 cm long, 6–13 mm wide, glabrous; apex subacute, terminating in a blunt knob; margin hyaline, irregular. *Glandular trichomes* 0.11–0.25 mm long; stalks translucent to yellow; heads black, flattened. Eglandular trichomes absent. *Scapes* 25–73 cm high, 1–2.6 mm wide, 1–4 per plant, glabrous except for clusters of glandular hairs immediately above each whorl of bracts and near the pedicel axils; sterile bracts arranged in 3 or 4 whorls and often scattered below the inflorescence, 6–12 mm long. Inflorescence 20–c.50-flowered, racemose. Floral bracts and bracteoles glabrous or glandular on margins. Bracts subulate, 2–7.5 mm long, 0.6–0.9 mm wide. Bracteoles 1–2.5 mm long. Pedicels 3–12 mm long, glandular. *Hypanthium* clavate to elliptic, 2–3.5 mm long, 0.9–1.9 mm wide, slightly longitudinally-ribbed, sparsely glandular throughout or with hairs confined to the upper half. Calyx lobes free, 2–4.5 mm long (2 slightly to noticeably longer than the remaining 3), 0.7–1.3 mm wide, glabrous or sparingly glandular on margin; margin entire; apex subacute to acute. *Corolla* yellow; abaxial surface yellow, or striped maroon, glabrous. Corolla tube 0.8–1.5 mm long. Corolla lobes laterally-paired, elliptic to obovate; anterior lobes 5–6.5 mm long, 2.8–4.5 mm wide; posterior lobes 4.5–6 mm long, 2.3–5 mm wide. *Labellum* fully twisted across calyx lobes; boss yellow, ovate, 0.6–1 mm long, 0.5–0.8 mm wide; margin entire, maroon; terminal appendage maroon; 0.1–0.8 mm long; lateral appendages absent. *Throat appendages* 6, broadly linear with slightly capitate tips, fused at base and arranged in a semi-circle, yellow, 0.6–1.2 mm long. *Column* 9.5–12 mm long. Anthers red–black; subtending hairs absent; pollen whitish to yellow. Stigma entire, sessile, elliptic, cushion-like. *Caspule* ellipsoidal, c. 4–4.5 mm long. Mature seed not viewed. (Figures 1, 2A)

Selected specimens examined. WESTERN AUSTRALIA [precise localities withheld for conservation purposes]: Brand Hwy, N of Waddi Rd, 9 Oct. 2002, *F. & J. Hort* 1852 (PERTH); Brand Hwy, N of Waddi Rd, 9 Oct. 2002, *F. & J. Hort* 1853 (PERTH); Wongonderrah Rd, 9 Oct. 2002, *F. & J. Hort* 1855 (PERTH); N of Mullering Brook Bridge on Gingin–Jurien Bay Rd, Sept. 1974, *S. James* 74.9/14 (PERTH); W of Badgingarra–Eneabba highway along Cadda Rd, Oct. 1971, *S. James* 71.10/42 (PERTH); E on Waddi Rd from Brand Hwy, 25 Oct. 2002, *J.A. Wege* JAW 752 (PERTH).

Distribution and habitat. *Stylidium hymenocraspedum* is known only from the Badgingarra area. Grows on sand in heath, or *Banksia* and *Eucalyptus tottiana* low open woodland.

Phenology. Flowers have been recorded from September to October.

Conservation status. Conservation Codes for Western Australian Flora: Priority Two. Whilst *S. hymenocraspedum* is represented within Badgingarra National Park, it is geographically restricted and known from only a few populations. In need of further survey.

Etymology. The specific epithet is taken from the Greek (*hymen* – membranous, *craspedus* – margined) in reference to the conspicuous hyaline leaf margin.

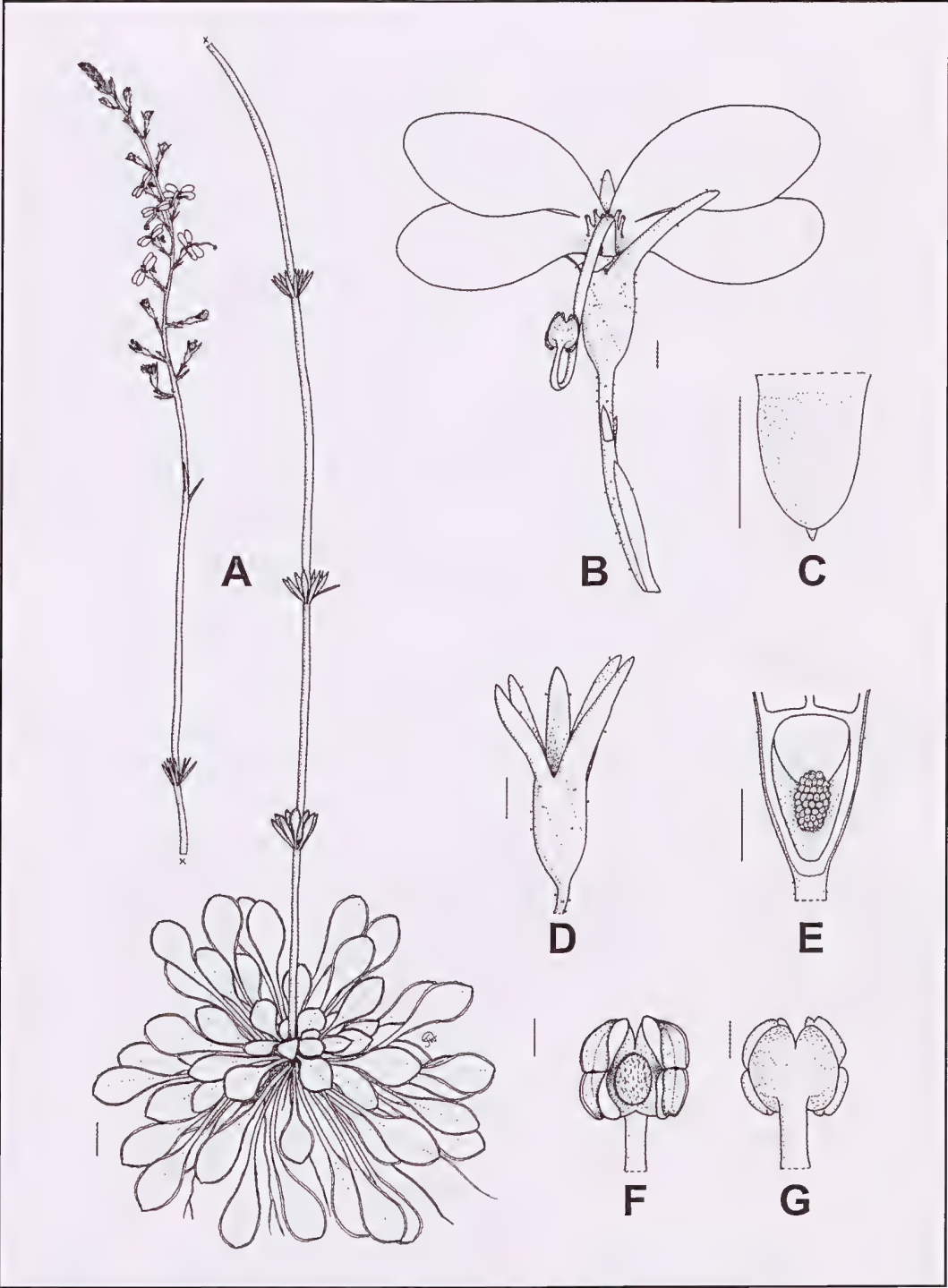


Figure 1. *Stylidium hymenocraspedum*. A – habit; B – flower; C – labellum; D – hypanthium and calyx lobes; E – L.S. of hypanthium; F – apex of column showing dehiscent anthers and developing stigma; G – apex of column showing connective region. Illustrations drawn from the following collections. A: F. & J. Hort 1854 (holotype); B–C: Hort s.n. (spirit collection); D–G: Wege JAW 752.

Chromosome number. James (1979) recorded a chromosome number of $n=12$ under *S. maitlandianum* (PERTH01060767).

Affinities. There are a number of morphological features that differentiate *S. hymenocraspedum* from *S. maitlandianum*. Plants tend to be more robust, and the flowers typically possess a longer column, and longer corolla lobes that are predominantly yellow rather than purple. Two of the calyx lobes are longer than the remaining three (this is particularly apparent in the bud stage), rather than of similar length (or only fractionally longer). Glandular hairs are present in the axils of the scape bracts unlike *S. maitlandianum*, in which they are absent or restricted to the uppermost whorl.

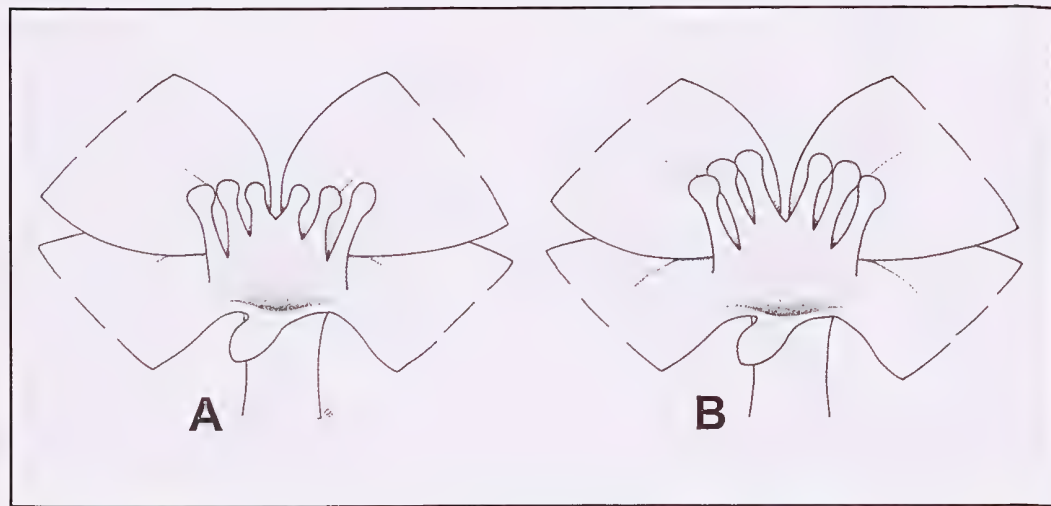


Figure 2. Throat appendage arrangement. A – *S. hymenocraspedum* (JAW 752); B – *S. maitlandianum* (JAW 917).

The throat appendages are a different colour in each species and, although comparable in shape, they are fused in a different manner. In *S. hymenocraspedum* they are fused at the base to form a semi-circular sheath, with the posterior appendages fused to about half their length across the posterior corolla lobes (Figure 2A). Although still fused at the base, the throat appendages in *S. maitlandianum* are arranged in two groups of three (Figure 2B). As noted by Raulings & Ladiges (2001), throat appendage number can vary within species of *Stylidium*, but the manner in which they are fused can be taxonomically informative.

Acknowledgements

This research was funded by an Australian Biological Resources Study grant. I thank the Directors and staff at BM, K, MEL, NSW, P, PERTH and W for their support and assistance; Fred and Jean Hort for their recent collection efforts; Terry Macfarlane, Jim Ross, Paul Wilson and an anonymous reviewer for their comments and assistance; and Carol Wilkins for field help.

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***Rhetinocarpha* (Asteraceae : Gnaphalieae)
– a new genus from Western Australia**

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Abstract

Wilson, Paul G. and Wilson, M.A. *Rhetinocarpha* (Asteraceae : Gnaphalieae) – a new genus from Western Australia. *Nuytsia* 16(1): 255–260 (2006). *Myriocephalus suffruticosus* Benth. is transferred to a new genus *Rhetinocarpha* Paul G. Wilson & M.A. Wilson. One new species combination is made: *R. suffruticosa* (Benth.) Paul G. Wilson & M.A. Wilson.

Introduction

During the preparation of an account of *Myriocephalus* for the Flora of Australia it became apparent that *M. suffruticosus* Benth. differed significantly from other members of the genus. However, the structure of the compound head was difficult to interpret, partly due to the paucity and unsatisfactory state of the available material, and partly due to the dry resinous substance that permeated between and through the various members of the capitulum. In addition, the bracts, pappus and florets readily separated from each other and from the capitulum when examined both in the dried state and when resuscitated in water.

The floral morphology remained unresolved until a population of this plant was discovered by Sue Patrick and Lesley Polomka in 1999 when they were carrying out a survey of rare flora for the Western Australian Department of Conservation and Land Management. Their collections, which included both flowering and fruiting material, enabled the flower head to be carefully examined and permitted a description to be prepared in greater detail than had previously been possible. An understanding of the capitulum was further enhanced by a collection made by us in December 2004 from which the accompanying illustrations were largely prepared.

Rhetinocarpha* Paul G. Wilson & M.A. Wilson, *gen. nov.

Herba perennis ramulis dense sericeis. Folia alterna, integra. Inflorescentia dense composita; bracteae involucri ungue dense lanoso, limbis albis, patulis. Receptaculum concavum vel planum, resinosum. Capitula numerosa, densa, breviter stipitata, 1–3-florifera, bractea subtenti tenui,

glandulosa, ad apicem ovoidea alba. Bracteae aliquot per capitulum, caducae, tenui, resinosae ad apicem ovoideae albae. Flosculi breviter stipitati, bisexuales. Corolla cylindrica, breviter 5-lobata, sparse glandulifera. Anthera inclusa; appendix breviter oblonga, subtilis; caudae delicatae breviter ramosae; stigmata truncata. Achenium cylindricum, laeve, glabrum; pericarpium diaphanum; testa aliquid coriacea, brunnea. Setae pappi c. 8, librae, filamentosae, ad apicem ovoideae, albae.

Typus: *R. suffruticosa* (Benth.) Paul G. Wilson & M.A. Wilson.

Perennial herb. Branches densely covered with a silvery silky indumentum. *Leaves* alternate, simple, entire. Inflorescence a dense compound head. *Bracts* of general involucre: claw densely woolly with oblong fenestrate stereome; limb white, spreading. General receptacle concave to flat, with globular resinous hairs. *Capitula* numerous, shortly stipitate, 1–3-flowered; subtending bract slender-terete, resinous, with white ovoid tip consisting of a number of ovoid cells fused together. Capitular bracts several, caducous, similar to capitulum subtending bract. Florets shortly stipitate, bisexual. *Corolla* regular, cylindrical, not expanded above; shortly 5-lobed, sparsely glandular at apex. *Anthers* included; appendage ovate, obtuse, delicate; tails short, slightly branched. *Stigma* truncate with obtuse sweeping hairs. *Achene* cylindrical, smooth, glabrous; pericarp diaphanous, vascular strands 2, in lateral position in relation to the cotyledons; testa somewhat coriaceous, brown, consisting of oblong cells. Pappus bristles c. 11, free, caducous, filiform, glabrous with milky white ovoid apex formed of fused ovoid cells.

Etymology. The generic name is derived from the Greek *rhétine* – resin, and *karpós* – chaff, with reference to the resinous capitular bracts found in the type species.

A monotypic genus endemic to south-western Western Australia.

Rhetinocarpha suffruticosa (Benth.) Paul G. Wilson & M.A. Wilson, *comb. nov.*

Myriocephalus suffruticosus Benth., *Fl. Austral.* 3:559(1867); *Hirnellia suffruticosa* (Benth.) Kuntze, *Rev. Gen. Pl.* 1:346(1891). *Type*: Between Moore and Murchison rivers, Western Australia, *J. Drummond* 6th coll. 153, 1853 (*holo*: K, photos seen; *iso*: MEL 542215, NSW, PERTH 1087339).

Woody perennial to 80 cm high with slender erect branches. *Leaves* scattered on slender branches and clustered on short axillary shoots; medial stem leaves linear-terete, shortly apiculate, 10–30 mm long becoming shorter towards the apex of the stem, revolute, glabrous and glossy above, densely silky villous beneath; leaves towards base of stem \pm flat, linear to narrowly oblong. Compound heads terminal to long, slender branches, depressed hemispherical, to 2 cm diam. *Bracts* of general involucre multi-rowed; claw oblong, woolly with broad stereome and narrow scarious margin; limb milky white, obovate, to 3 mm long decreasing adaxially. Capitular stipe 0.3–0.5 mm long, c. 0.3 mm diameter, densely covered with globular resinous hairs and surmounted by 1–3 bracts shortly exceeding florets; capitular bracts with curved cartilaginous base, slender terete glandular claw, and white ovoid apex. Florets 2 or 3, stipitate; stipe 0.1–0.3 mm long, glabrous or with a few globular resinous hairs at apex, reddish brown, subtended by a bract similar to capitular bracts. *Corolla* tubular, c. 3 mm long, sparsely glandular. *Achene* broadly cylindrical, c. 1.2 mm long, 0.6 mm

diam., truncate at apex and base, smooth, reddish brown; carpophore minute. Pappus bristles 8–11, filiform, glabrous, with milky white ovoid apex, shortly exceeding corolla, caducous. (Figures 1, 2)

Selected specimens examined. WESTERN AUSTRALIA: N of Dandaragan, 28 Sept. 1988, *E.A. Griffin* 5290 (PERTH); near Badgingarra, 1 Dec. 1999, *L. Polomka & S. Patrick* 3347 (PERTH); Badgingarra, 26 Nov. 1974, *R. Smith s.n.* (PERTH); Badgingarra district, 8 Dec. 2004, *P.G. Wilson* 13078 & *M.A. Wilson* (PERTH).

Distribution. Known only from the Badgingarra – Dandaragan area of western Western Australia, c. 180 km north of Perth.

Habitat. This species has been found growing on the side of lateritic ridges in open Wandoo (*Eucalyptus wandoo*) woodland.

Flowering period. November and December.

Conservation status. Conservation Codes for Western Australian Flora: Priority One. No populations have been recorded on a conservation estate.

Notes. The stipes that supports the capitula are persistent and continuous with the receptacle; evidently they are developmentally part of the receptacle and bear the same type of resinous hairs. These resinous hairs are globular and are borne on a very short 2–3-celled stipe. They eventually make the capitulum extremely resinous, however, the resin is soluble in water and presumably the first rains of the season allow the achenes to disperse.

This species was included in *Myriocephalus*, a genus that had become extremely polymorphic with the inclusion of several elements that bore no close relationship to each other (Short *et al.* 1989; Short 1993, 2000). *Rhetinocarpha* differs from the species now recognised in *Myriocephalus* (Short 1993; Wilson 2002) in having a strongly resinous capitulum, slender-terete (not obovate and hyaline) capitular bracts, stipitate florets, and glabrous achenes with a hyaline pericarp.

It has been observed by Anne Cochrane (PERTH, pers. comm.) that when heated the flower heads emit a strong camphor smell.

The genus is possibly most closely related to *Argentipallium* for this genus has florets with similar types of corolla, stigmas, achene, and pappus bristles. The leaves agree with those of *Argentipallium obtusifolium* both in shape and in the possession of an appressed silvery indumentum. If the suggested affinity is correct then *Rhetinocarpha* (which has a compound head) would appear to have a comparable relationship to *Argentipallium* (the species of which have simple heads) as *Cephalipterum drummondii* (with compound heads) has to species in *Rhodanthe* section *Leiochrysum* (see Wilson 1992).

The terminology used to describe the floral bracts follows that of Short (1983).



Figure 1. *Rhetinocarpha suffruticosa*. A – flowering plant ($\times \frac{1}{2}$), B – flower heads from side ($\times 3$), C – flower head from above ($\times 3$), D – florets with associated pappus bristles and floral bracts from above ($\times 20$), E – a 2-flowered capitulum ($\times 30$), F – achene ($\times 25$), G – T.S. achene ($\times 25$), H – style ($\times 30$). Drawn from P.G. Wilson & M.A. Wilson 13078.

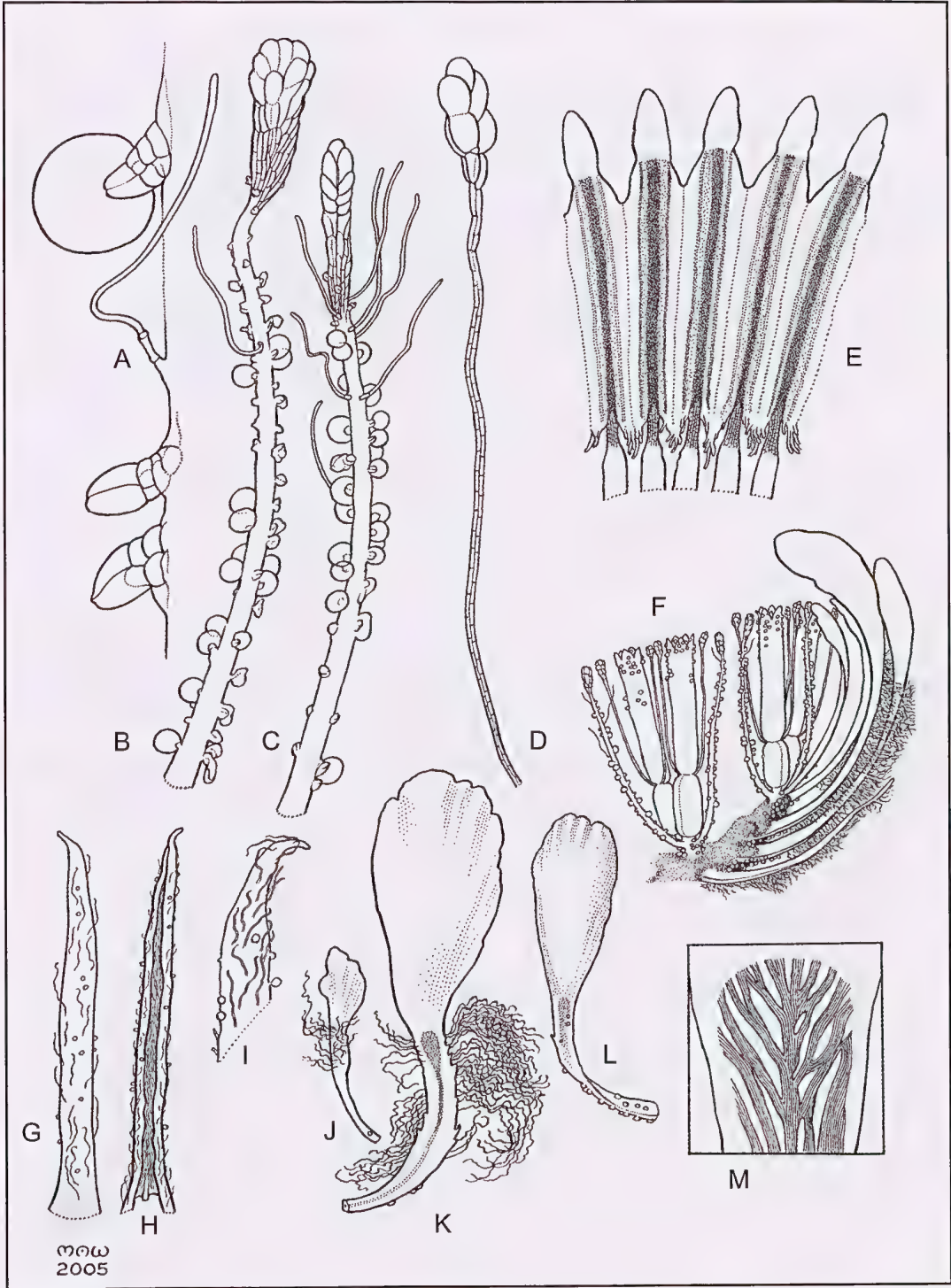


Figure 2. *Rhetinocarpha suffruticosa*. A – hairs on capitular bract ($\times 300$), B – capitular bract ($\times 20$), C – capitular bract ($\times 20$), D – pappus bristle ($\times 20$), E – anthers ($\times 60$), F – longitudinal radial section through side of compound head ($\times 6$), G – leaf, adaxial surface ($\times 5$), H – leaf abaxial surface ($\times 5$), I – tip of leaf, adaxial surface ($\times 8$), J – outer involucre bract ($\times 14$), K – medial involucre bract ($\times 14$), L – inner involucre bract ($\times 14$), M – stereome of medial bract, cleared ($\times 30$). Drawn from P.G. Wilson & M.A. Wilson 13078.

Acknowledgements

We have been assisted by the careful collections made by Leslie Polomka and Sue Patrick (PERTH) and for their notes on its habitat. Pauline and Bruce Cook made us welcome on a visit to their farm near Badginarra where we were able to inspect the plant *in situ*. Comments by the referee have been incorporated into this paper. The Melbourne herbarium (MEL) sent on loan an isotype of *Myriocephalus suffruticosus*. The work on this genus was carried out while one of us (PGW) was in receipt of a contract from the Australian Biological Resources Study to prepare an account of the genus *Myriocephalus* for the Flora of Australia.

The illustration tab. 1, prepared by MAW, is copyright Australian Biological Resources Study who kindly permitted the use of it in this paper.

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Corrections to *Nuytsia* 15(3)

On page 375, in 'Other specimens examined', specimen citations for both *Keighery and Gibson* 1453 and 1535 refer to collecting sites for *Drosera prostrata* which are "W of Great Northern Highway". These should read "W of North West Coastal Highway".

On page 378, in 'Other specimens examined', a specimen of *Drosera purpurescens* is listed as "*E.J. Croxford* 2887A". The correct collecting number for this specimen is "*E.J. Croxford* 2687A".

On page 477, in the type citation of *Petrophile pilostyla* subsp. *austrina*, the herbarium sheet number for the holotype is given as PERTH 05423708, which is incorrect. The correct sheet number for the specimen cited is PERTH 06230628.

CONSERVATION CODES FOR WESTERN AUSTRALIAN FLORA

R: Declared Rare Flora – Extant Taxa (= Threatened Flora = Endangered + Vulnerable)

Taxa which have been adequately searched for, and are deemed to be in the wild either rare, in danger of extinction, or otherwise in need of special protection, and have been gazetted as such, following approval by the Minister for the Environment, after recommendation by the State's Threatened Species Scientific Committee.

X: Declared Rare Flora – Presumed Extinct Taxa

Taxa which have not been collected, or otherwise verified, over the past 50 years despite thorough searching, or of which all known wild populations have been destroyed more recently, and have been gazetted as such, following approval by the Minister for Environment, after recommendation by the State's threatened Species Scientific Committee.

1: Priority One – Poorly Known Taxa

Taxa which are known from one or a few (generally <5) populations which are under threat, either due to small population size, or being on lands under immediate threat, e.g. road verges, urban areas, farmland, active mineral leases, etc., or the plants are under threat, e.g. from disease, grazing by feral animals, etc. May include taxa with threatened populations on protected lands. Such taxa are under consideration for declaration as 'rare flora', but are in urgent need of further survey.

2: Priority Two – Poorly Known Taxa

Taxa which are known from one or a few (generally <5) populations, at least some of which are not believed to be under immediate threat (i.e. not currently endangered). Such taxa are under consideration for declaration as 'rare flora', but are in urgent need of further survey.

3: Priority Three – Poorly Known Taxa

Taxa which are known from several populations, at least some of which are not believed to be under immediate threat (i.e. not currently endangered). Such taxa are under consideration for declaration as 'rare flora', but are in need of further survey.

4: Priority Four – Rare Taxa

Taxa which are considered to have been adequately surveyed and which, whilst being rare (in Australia), are not currently threatened by any identifiable factors. These taxa require monitoring every 5–10 years.

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NUYTSIA is a refereed journal that publishes original papers on systematic botany with preference given to papers relating to the flora of Western Australia. Its scope includes revisionary studies and systematic analyses of native plant groups, papers publishing new species or drawing attention to potential new invasive species, and short communications of taxonomic and nomenclatural clarifications.

Style and layout should follow recent numbers of *NUYTSIA*, noting particularly the following.

Title. Should include the family name of genera or species treated, but not authorities. New taxa should be named if not numerous. The geographic area of study should be given where appropriate.

Abstract. The paragraph (or paragraphs) should be indented and commence with bibliographic information. New taxa, combinations and names should be listed. The major contents of the paper should be summarized but no additional material given.

Headings. All headings should be in capitals and lower case, major headings being centred and minor ones left-justified.

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Species treatments. Use of certain named paragraphs, or sets of paragraphs, for matter following the descriptions is encouraged. The desired sequence and examples of commonly-used headings are shown below. Recommended headings, italicized below, should be left-justified, followed by text on the same line.

Taxon name, synonymy (if any), significant manuscript or phrase names and type details (for previously published taxa).

Latin (for new taxa - indented).

Typus: (for new taxa - not indented).

English description (indented).

Other specimens examined or *Selected specimens examined*, as appropriate.

Distribution.

Habitat.

Phenology or *Flowering period.*

Conservation status. Department of Conservation and Land Management conservation codes for rare and threatened (Declared Rare Flora and Priority Flora) WA taxa are given in each issue. Status is reviewed and assigned by Departmental staff.

Etymology.

Typification.

Affinities or *Relationships.*

Discussion or *Comments* or *Notes.*

Threatened species. It is the policy of DEC not to publish precise locality data for threatened species. Authors are therefore requested not to cite precise locality data when describing threatened species. Generalized localities should be given accompanied by the statement - [precise locality withheld].

Synonymy. Recent papers should be consulted for examples of an appropriate format for citing synonyms.

Standard abbreviations. Where abbreviations are used, the following standards should be followed:

- Author abbreviations:
 - Brummitt, R.K. & Powell, C.E. (1992). *Authors of Plant Names*. (Royal Botanic Gardens: Kew.)
- Book titles in literature citations:
 - Stafleu, F.A. & Cowan, R.S. (1976–83). *Taxonomic Literature*. Edn 2. (I.A.P.T.: Utrecht) (but with capital initial letters.)
 - Green, J.W. (1985). *Census of the Vascular Plants of Western Australia*. Edn 2. Pp. 2024. (Dept of Agriculture: Perth.)
- Journal titles in literature citations and reference lists:
 - Lawrence, G.H.M. *et al.* (1968). *Botanico-Periodicum-Huntianum* (B-P-H).
 - Green *op. cit.*

Figures. Numbers should follow a single sequence, including maps.

References. Citation of references in the text should be of the form *author's surname (year)* or (*year: page*) with full details given in the Reference section. This format is also recommended to replace the traditional abbreviations for references listed under taxonomic names, for example using Bentham (1878: 234) instead of Benth., *Fl. Austral.* 7: 234 (1878).

Structure of papers. Authors are encouraged to use the conventional structure of scientific papers when a complete study is being reported (e.g. a revision).

A *Methods* section should include the method of drawing up the descriptions from specimens, extent of search for types, and discussion of concepts for choice of taxonomic categories.

A *Discussion* section should be considered, which would include some or all of the following: a summary of the findings, emphasizing the most significant; interpretation of the results in the light of other relevant work; statement of new problems which have arisen; advising of aspects which are to be followed up; suggestion of topics which others might usefully pursue; prediction and speculation.

Descriptions and keys using manuscript or phrase names will not generally be accepted. All papers are refereed and the Editorial Advisory Committee reserves the right to reject papers. Opinions expressed by authors are their own and do not necessarily represent the policies or views of the Department of Conservation and Land Management.

After final acceptance of papers, authors are requested to provide final versions of files on disc or by email and readable directly personal computer. Text should be provided in MS-WORD compatible format. Within a paragraph two spaces are required between sentences; after colons, semicolons, commas and dashes a single space is required. Latin names should be italicized.

Original figures should not be lettered but accompanied by copies indicating lettering. If digital images are submitted for figures they should be at a minimum resolution of 300 dpi, preferably in a lossless file format such as TIF.

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